



GROUP B

FINSCOPE 3D -

DATA RETRIEVAL X
DOCUMENT ANALYSIS X
DATA-DRIVEN PREDICTION

Team Mentor: Jerry Liao, Ti-Wen

Team Member: Jay Wu, Ray Chang, Yu-Ting Chen, Ingrid Tseng



SC201 AI PROJECT



PART 0

INTRODUCTION

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

(Mark One)

ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For the fiscal year ended September 29, 2018

or

TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For the transition period from _____ to _____

Commission File Number: **001-36743**



Apple Inc.

(Exact name of Registrant as specified in its charter)

California

(State or other jurisdiction
of incorporation or organization)

**One Apple Park Way
Cupertino, California**

(Address of principal executive offices)

94-2404110

(I.R.S. Employer Identification No.)

95014

(Zip Code)

(408) 996-1010

(Registrant's telephone number, including area code)

Securities registered pursuant to Section 12(b) of the Act:

Common Stock, \$0.00001 par value per share

**1.000% Notes due 2022
1.375% Notes due 2024
0.875% Notes due 2025
1.625% Notes due 2026
2.000% Notes due 2027
1.375% Notes due 2029
3.050% Notes due 2029
3.600% Notes due 2042**

(Title of each class)

**The Nasdaq Stock Market LLC
New York Stock Exchange LLC**

(Name of each exchange on which registered)

Finscope3D

Apple Inc.

Form 10-K

For the Fiscal Year Ended September 29, 2018

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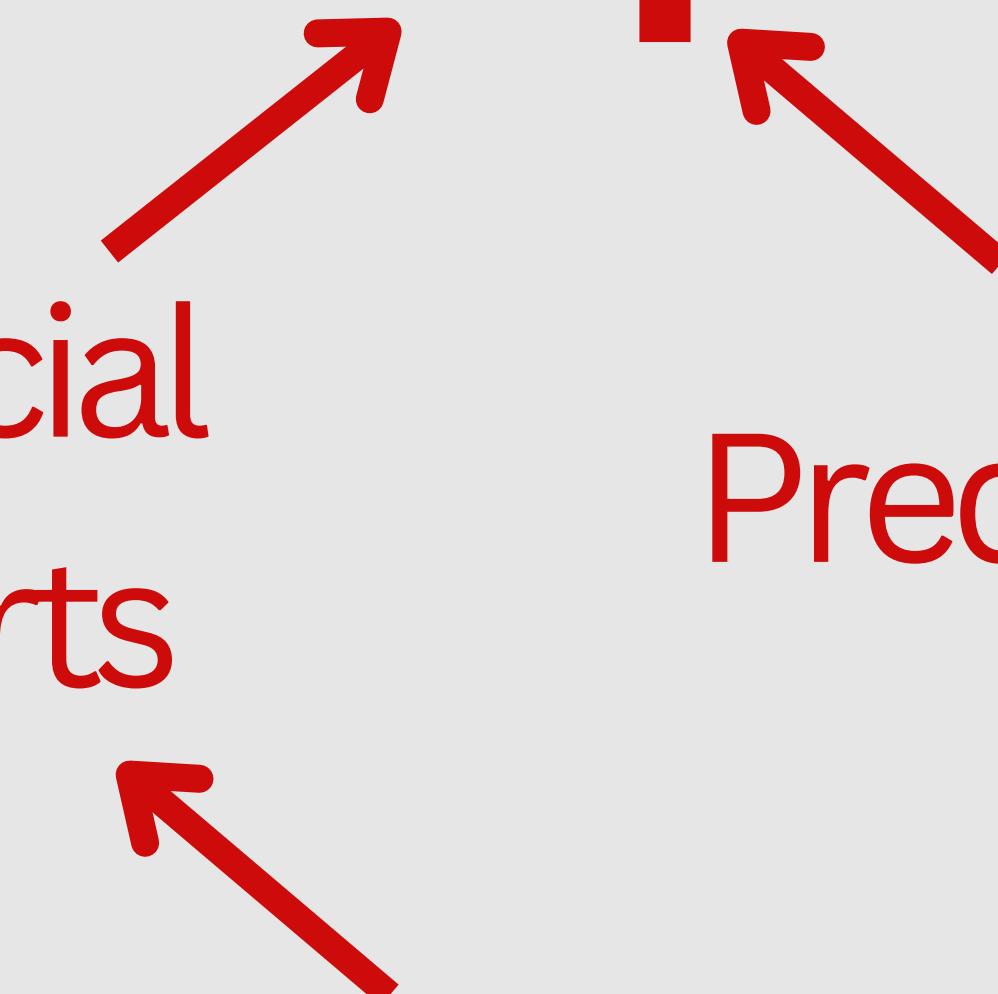
This Annual Report on Form 10-K ("Form 10-K") contains forward-looking statements, within the meaning of the Private Securities Litigation Reform Act of 1995, that involve risks and uncertainties. Many of the forward-looking statements are located in Part II, Item 7 of this Form 10-K under the heading "Management's Discussion and Analysis of Financial Condition and Results of Operations." Forward-looking statements provide current expectations of future events based on certain assumptions and include any statement that does not directly relate to any historical or current fact. Forward-looking statements can also be identified by words such as "future," "anticipates," "believes," "estimates," "expects," "intends," "plans," "predicts," "will," "would," "could," "can," "may," and similar terms. Forward-looking statements are not guarantees of future performance and the Company's actual results may differ significantly from the results discussed in the forward-looking statements. Factors that might cause such differences include, but are not limited to, those discussed in Part I, Item 1A of this Form 10-K under the heading "Risk Factors," which are incorporated herein by reference. All information presented herein is based on the Company's fiscal calendar. Unless otherwise stated, references to particular years, quarters, months or periods refer to the Company's fiscal years ended in September and the associated quarters, months and periods of those fiscal years. Each of the terms the "Company" and "Apple" as used herein refers collectively to Apple Inc. and its wholly-owned subsidiaries, unless otherwise stated. The Company assumes no obligation to revise or update any forward-looking statements for any reason, except as required by law.

Finscope3D

Financial
Reports

Text Numbers

(Document Analysis)



Apple Inc.

CONSOLIDATED STATEMENTS OF OPERATIONS

(In millions, except number of shares which are reflected in thousands and per share amounts)

	Years ended		
	September 29, 2018	September 30, 2017	September 24, 2016
Net sales	\$ 265,595	\$ 229,234	\$ 215,639
Cost of sales	163,756	141,048	131,376
Gross margin	101,839	88,186	84,263
Operating expenses:			
Research and development	14,236	11,581	10,045
Selling, general and administrative	16,705	15,261	14,194
Total operating expenses	30,941	26,842	24,239
Operating income	70,898	61,344	60,024
Other income/(expense), net	2,005	2,745	1,348
Income before provision for income taxes	72,903	64,089	61,372
Provision for income taxes	13,372	15,738	15,685
Net income	\$ 59,531	\$ 48,351	\$ 45,687
Earnings per share:			
Basic	\$ 12.01	\$ 9.27	\$ 8.35
Diluted	\$ 11.91	\$ 9.21	\$ 8.31
Shares used in computing earnings per share:			
Basic	4,955,377	5,217,242	5,470,820
Diluted	5,000,109	5,251,692	5,500,281

See accompanying Notes to Consolidated Financial Statements.

Finscope3D

Financial
Reports

Text Numbers

(Document Analysis) (Data Retrieval)



Prediction

217.9 USD ▼5.95 (2.66%)

收盤 | 2025/03/29 04:00 台北時間

[當日](#) [5天](#) [1個月](#) [6個月](#) [今年](#) [1年](#) [5年](#) [全部](#)**Apple Inc.即時行情**

225.00	成交	217.9	昨收	223.85
223.85	開盤	221.65	漲跌幅	▼ 2.66%
222.00	最高	223.8	漲跌	▼ 5.95
219.00	最低	217.68	總量	39,525,987
216.00	一年內最高	260.10	一年內最低	164.08
	買進	217.76	賣出	217.84
	EPS (TTM)	6.30	總市值	3.273T
	PE Ratio (TTM)	34.59		

註：TTM (Trailing Twelve Months) 數據是滾動的概念，根據時間的推進而變化。表示連續 12 個月內的統計數據或最近 4 個季度數據。

Finscope3D

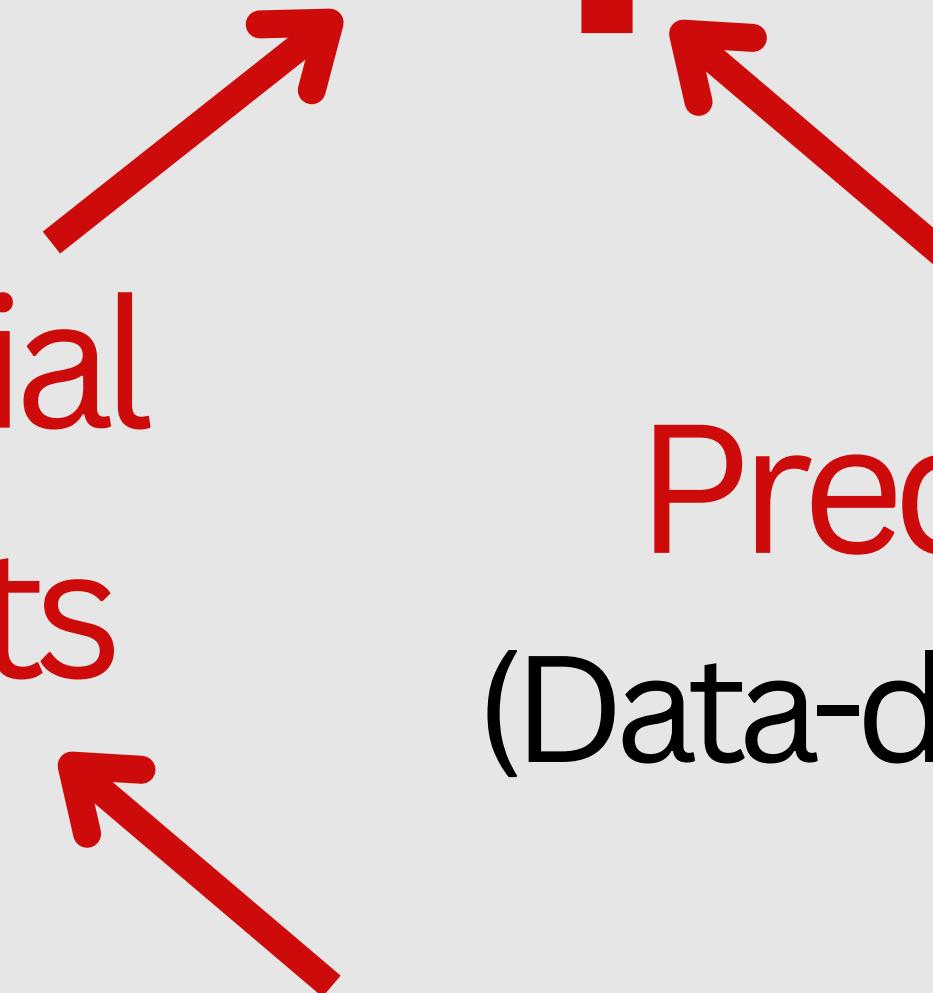
Financial
Reports

Text

(Document Analysis) (Data Retrieval)

Prediction
(Data-driven Prediction)

Numbers



Finscope3D

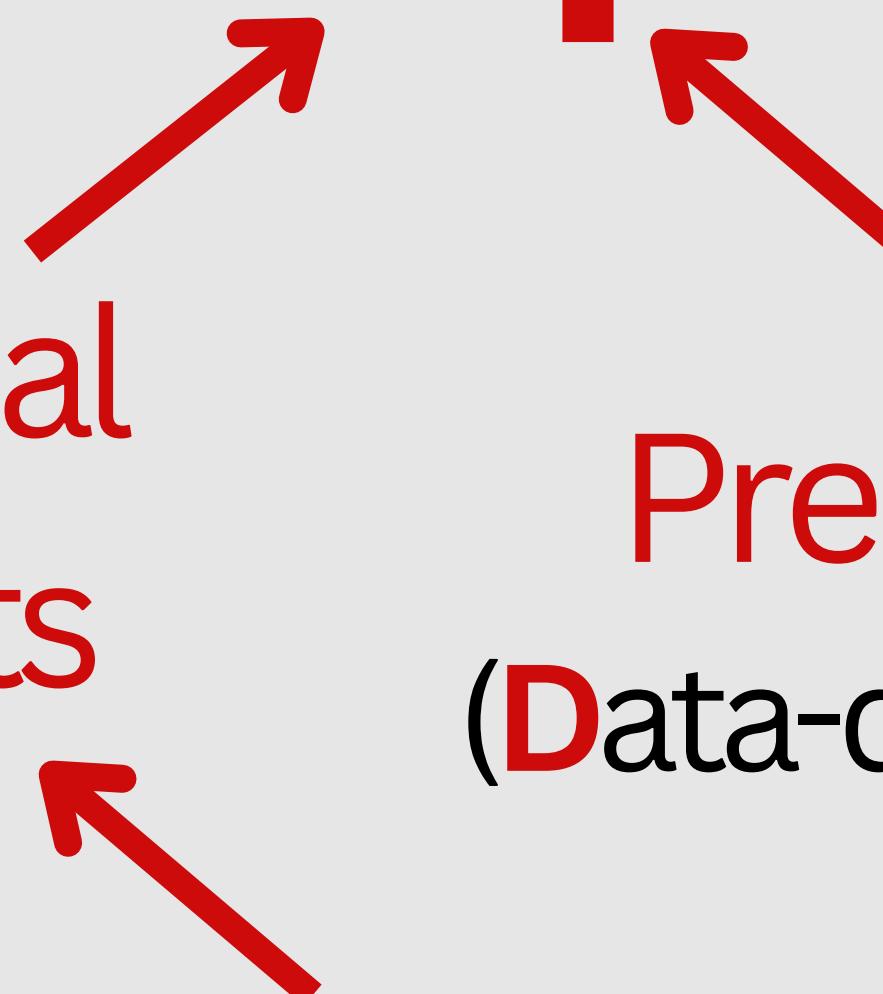
Financial
Reports

Text

(Document Analysis)

Numbers

Prediction
(Data-driven Prediction)





PART 0

FINSCOPE 3D

Demo



FinScope 3D

Data Retrieval × Document Analysis × Data-Driven Prediction.

For **NASDAQ-100** companies within **2020-2025!**

Multilingual: Ask your question in English, Chinese, Japanese, or Korean.

We support three types of financial questions:

1. **Data Retrieval:** Ask about specific numbers in financial reports, e.g., revenue, EPS, or profit.

2. **Document Analysis:** Ask about business strategies, risks, or management discussions.

3. **Data-Driven Prediction:** Get a general forecast on whether a company's stock is likely to outperform or underperform the market — no exact prices provided.

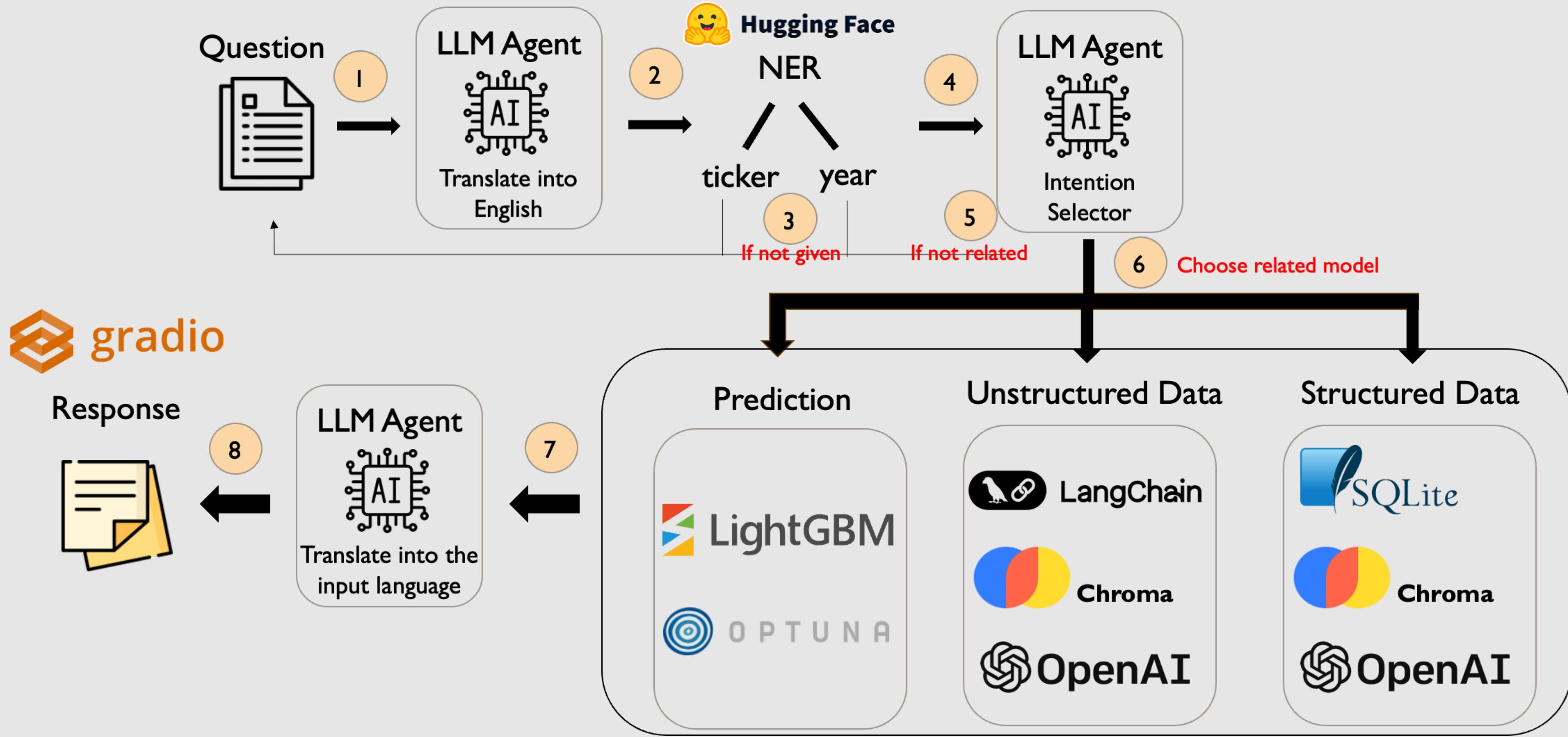
Chatbot

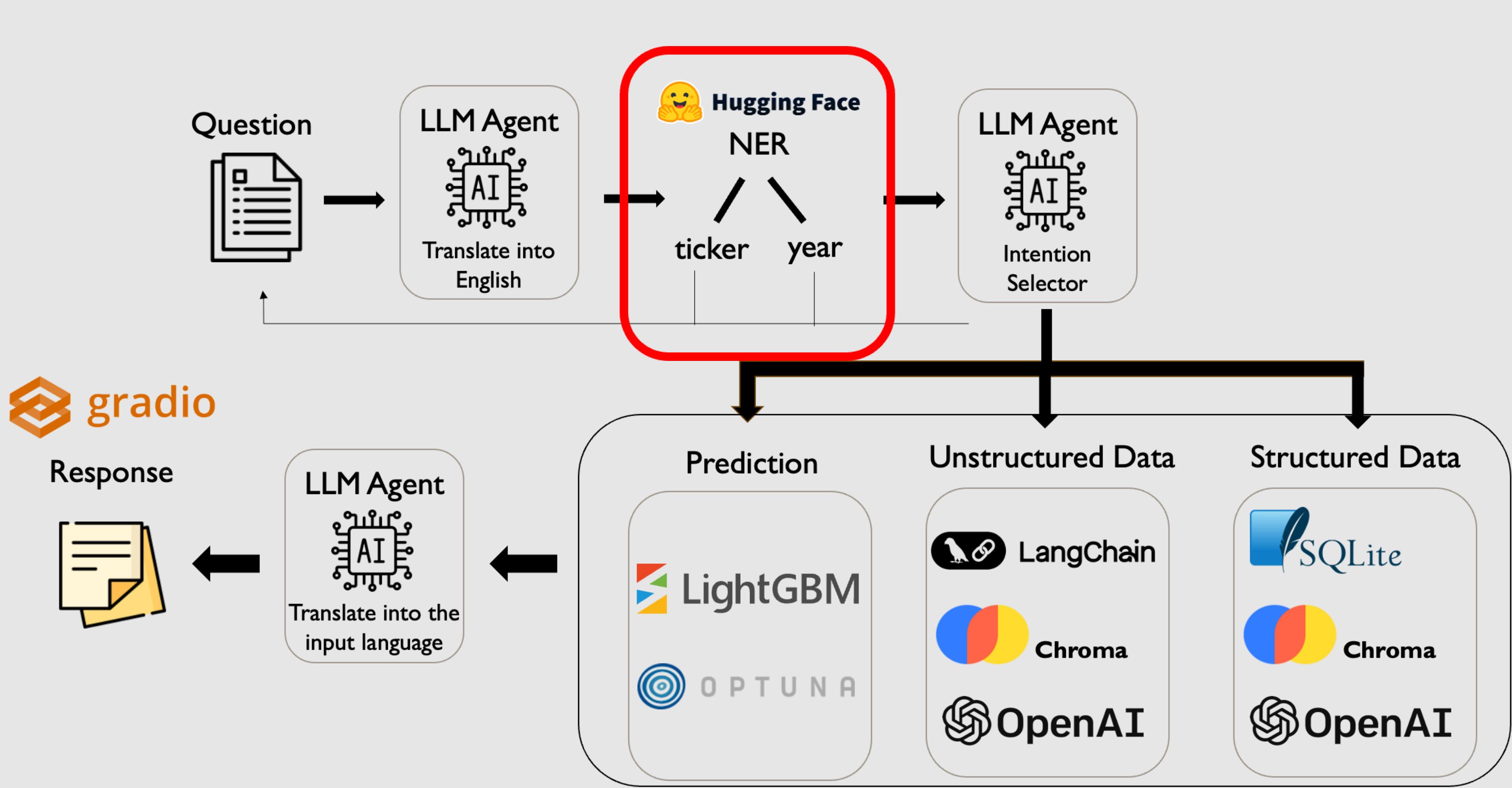
Your Message

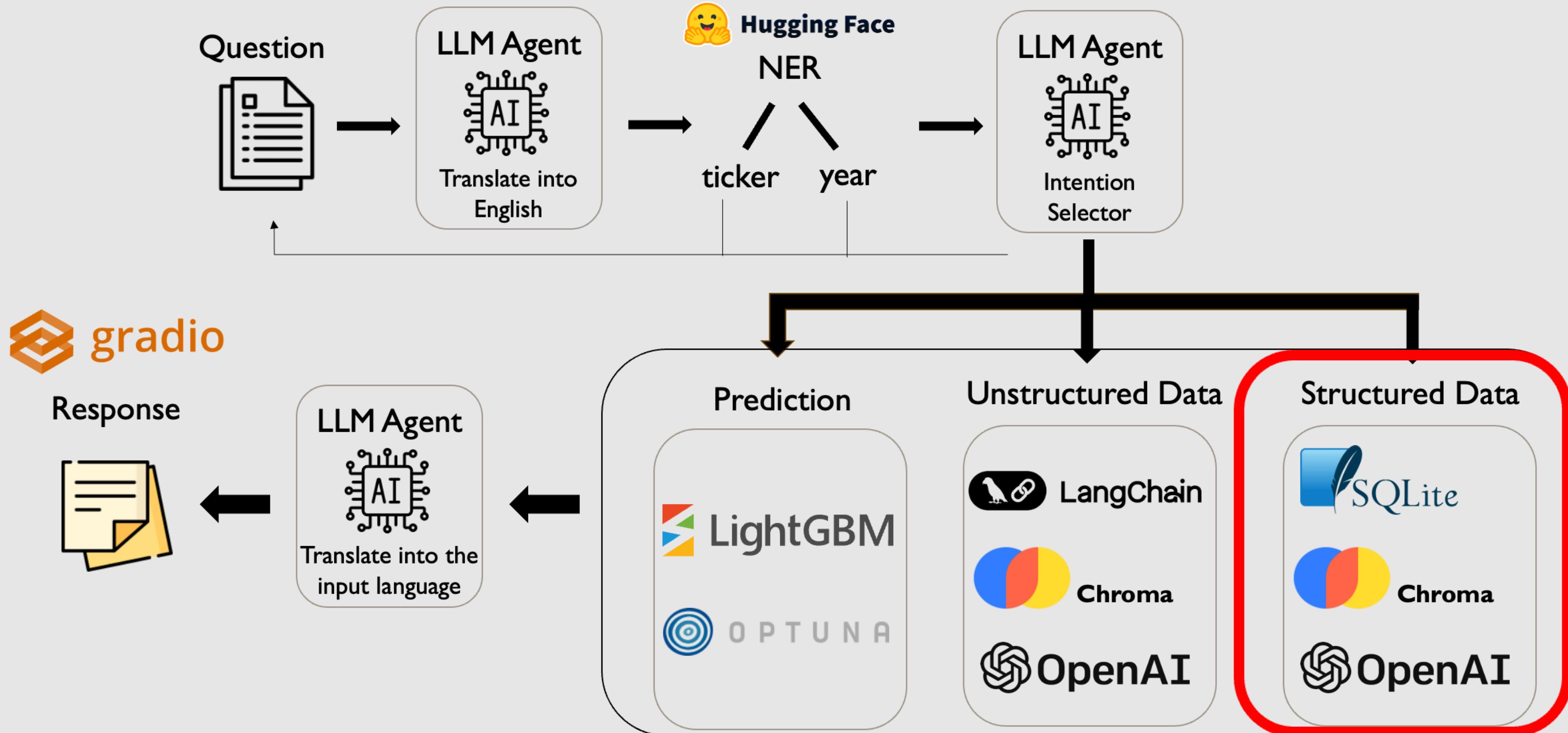
What was Apple's revenue in 2023?

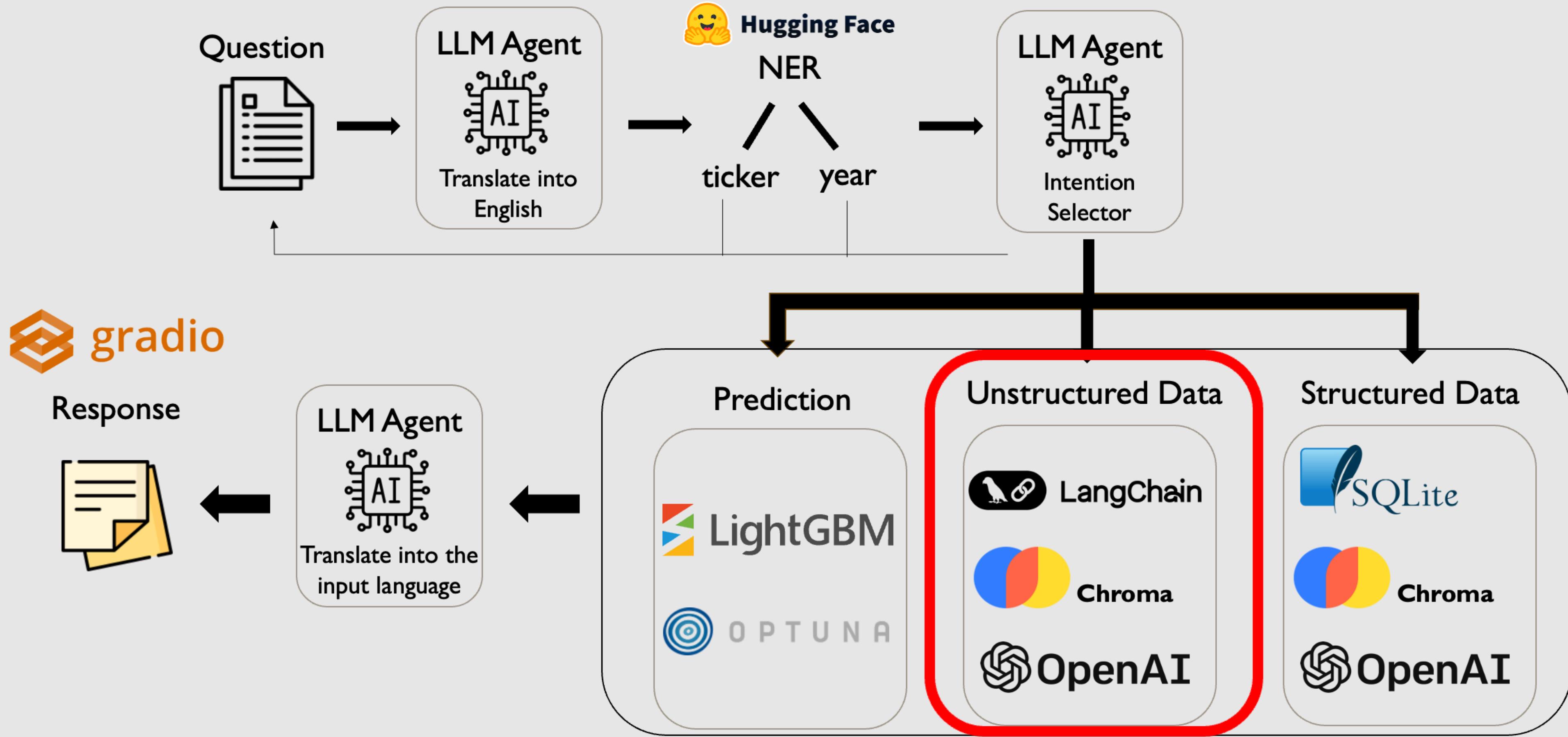
Enter

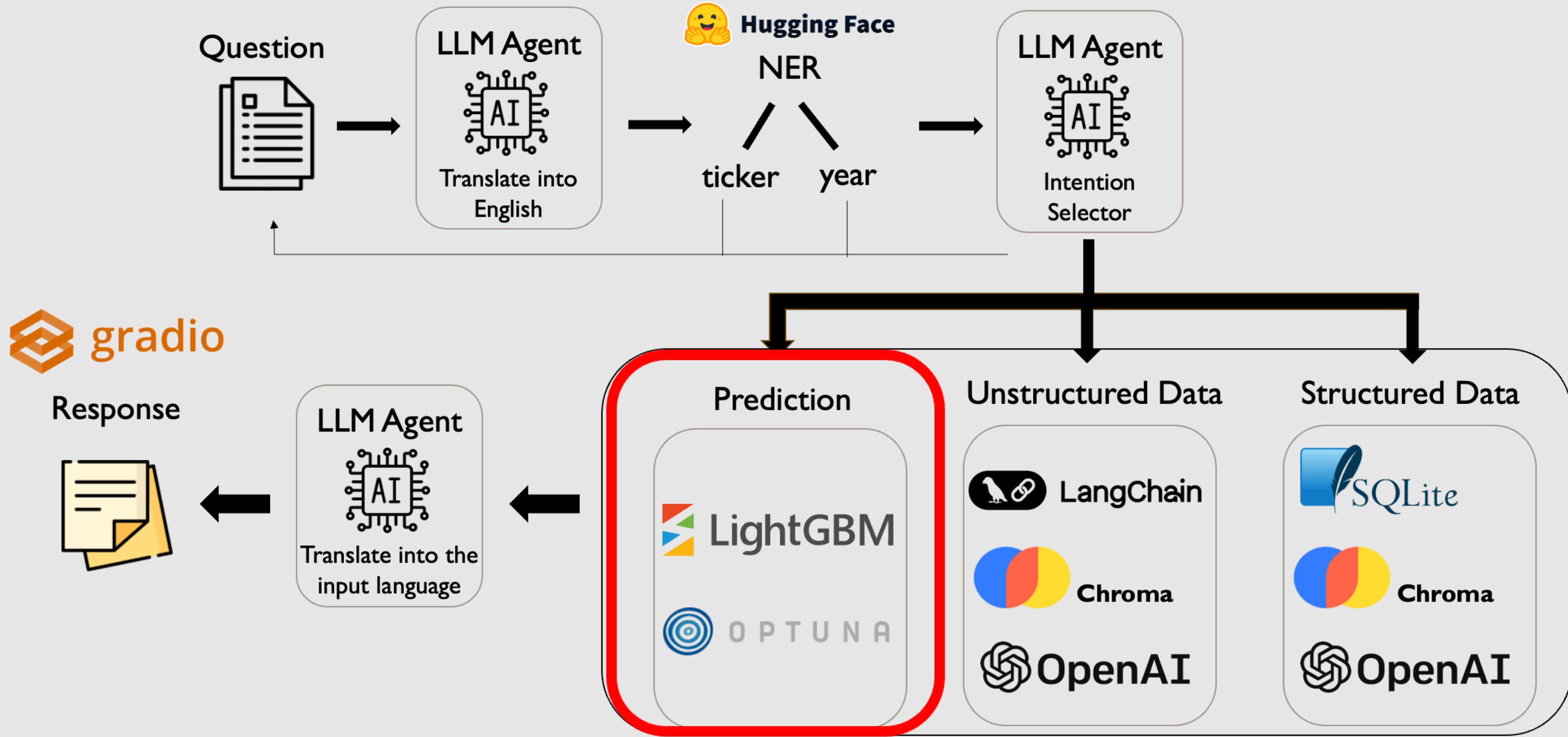
Clear

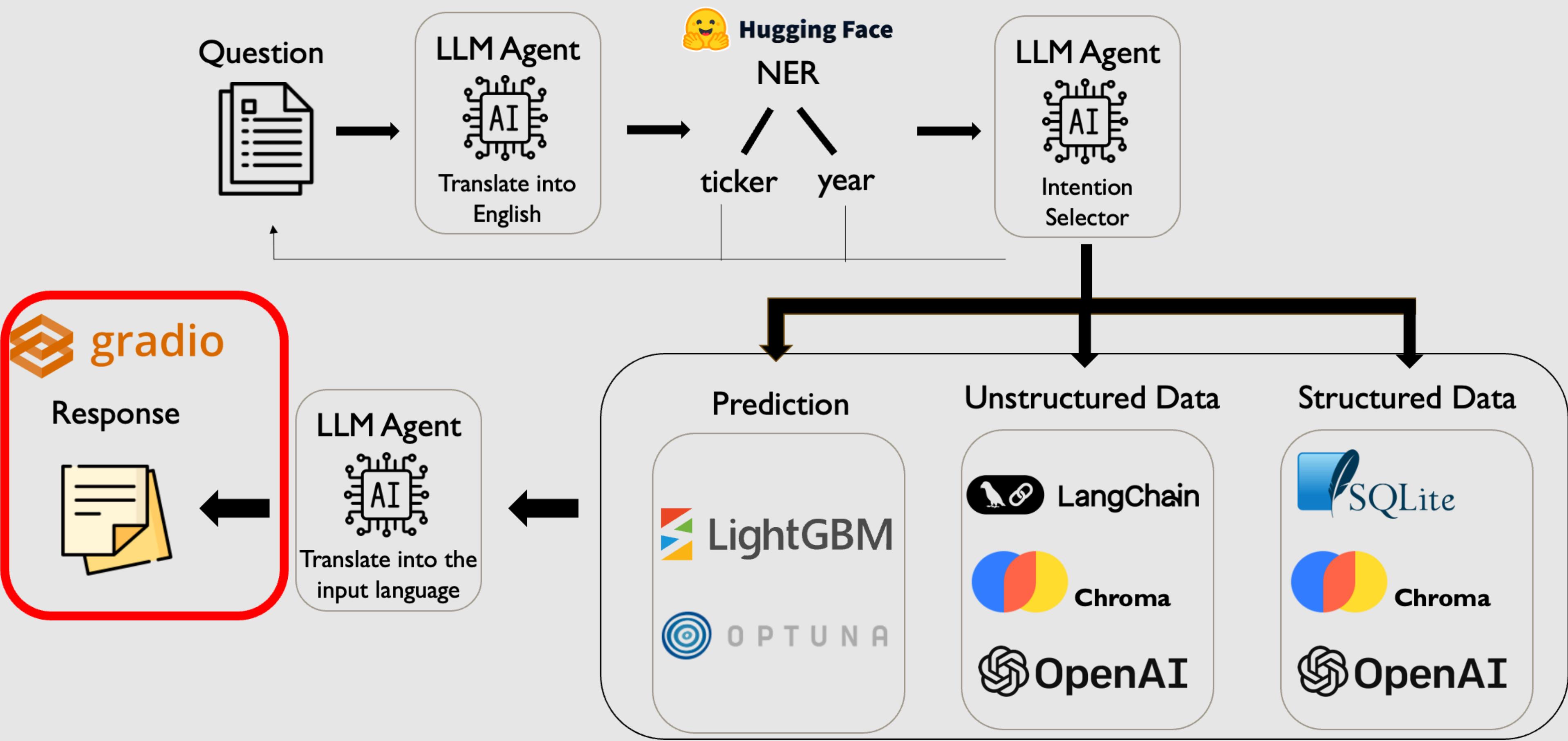












INTRODUCTION

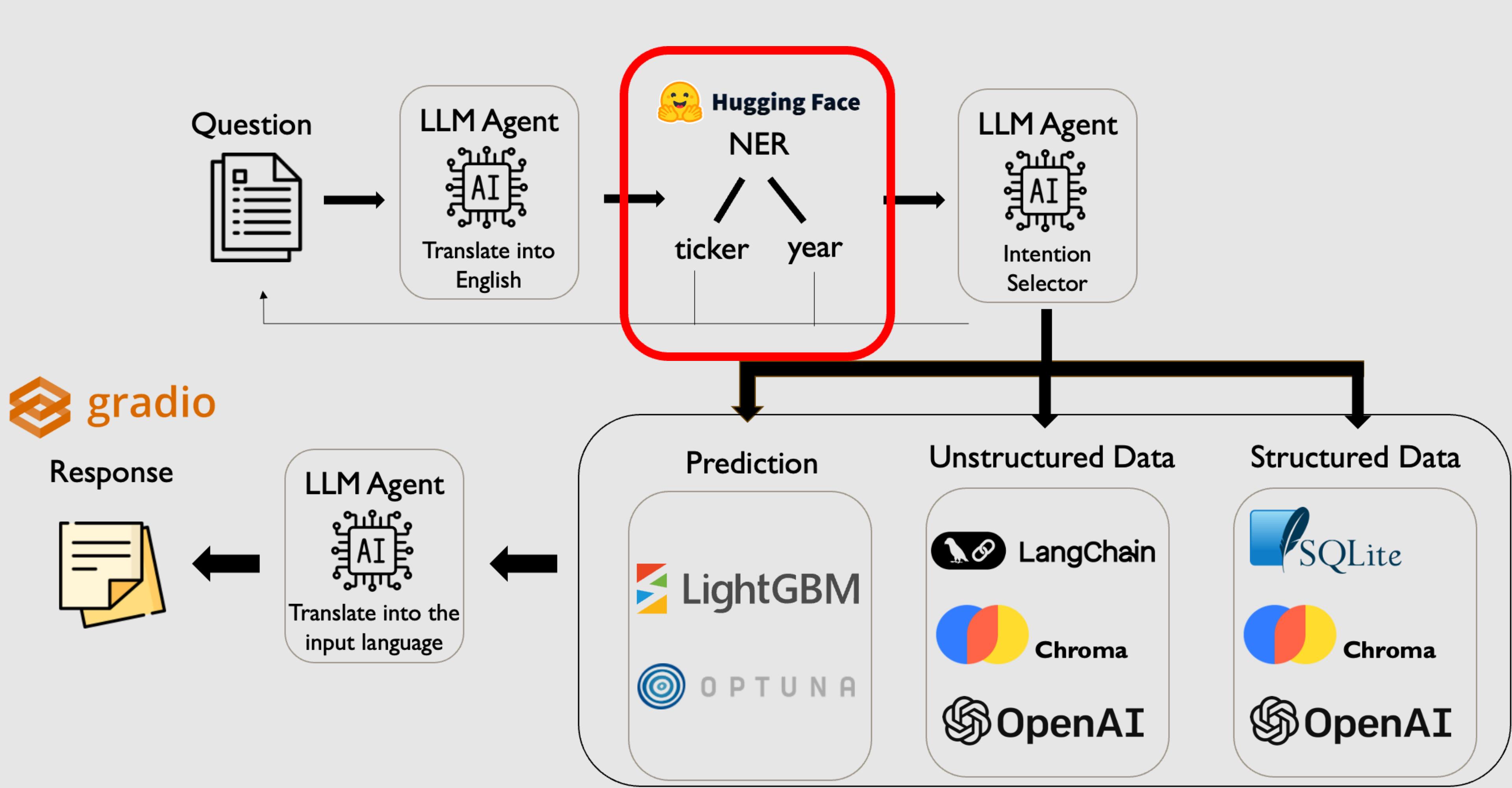
- 1.NER model - What is NER?
2. Structured Data
3. Unstructured Data
4. Prediction - Price prediction in long term-LightGBM



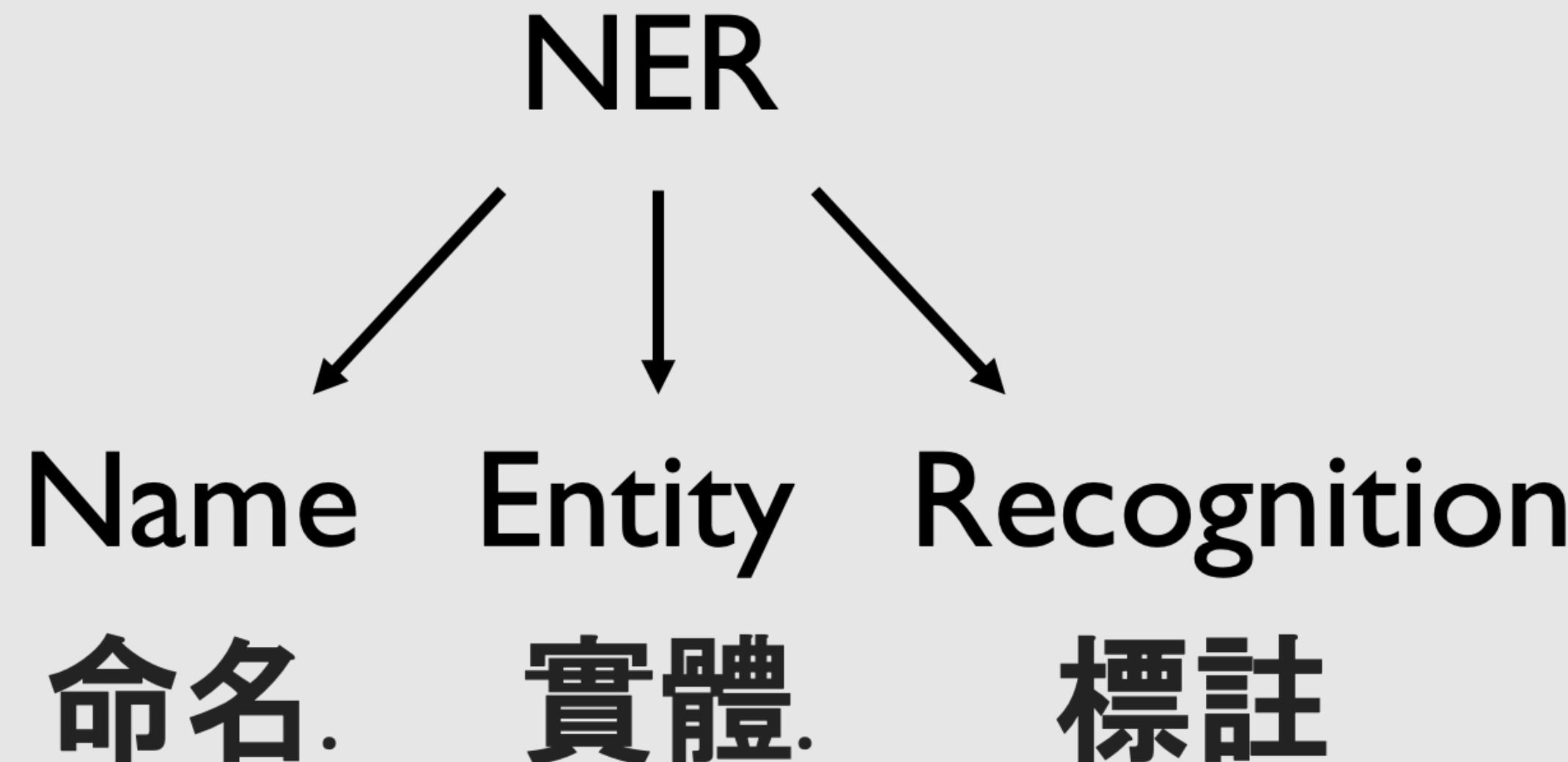
PART1

NER MODEL

What is NER?



NER MODEL



NER MODEL

Please tell me Apple's revenue in 2024.

NER MODEL

Please tell me Apple's revenue in 2024.



Organization

Year

WHY USE NER?

How can NER help us in this topic?



WHY USE NER?

- It can help reduce hallucinations
- Accurate Extraction of Key Information
- Restricting Query Scope

WHY USE NER?

Hugging Face Models Datasets Spaces Posts Docs Enterprise Pricing Log In Sign Up

flair/flair/ner-english-ontonotes-large like 94 Follow flair 42

Token Classification Flair PyTorch ontonotes English sequence-tagger-model arxiv:2011.06993

Model card Files and versions Community 3 Deploy Use this model

English NER in Flair (Ontonotes large model)

This is the large 18-class NER model for English that ships with [Flair](#).

F1-Score: **90.93** (Ontonotes)

Downloads last month **166,838**

Inference Providers NEW HF Inference API Examples

Token Classification



WHY USE NER?

tag	meaning
CARDINAL	cardinal value
DATE	date value
EVENT	event name
FAC	building name
GPE	geo-political entity
LANGUAGE	language name
LAW	law name
LOC	location name
MONEY	money name

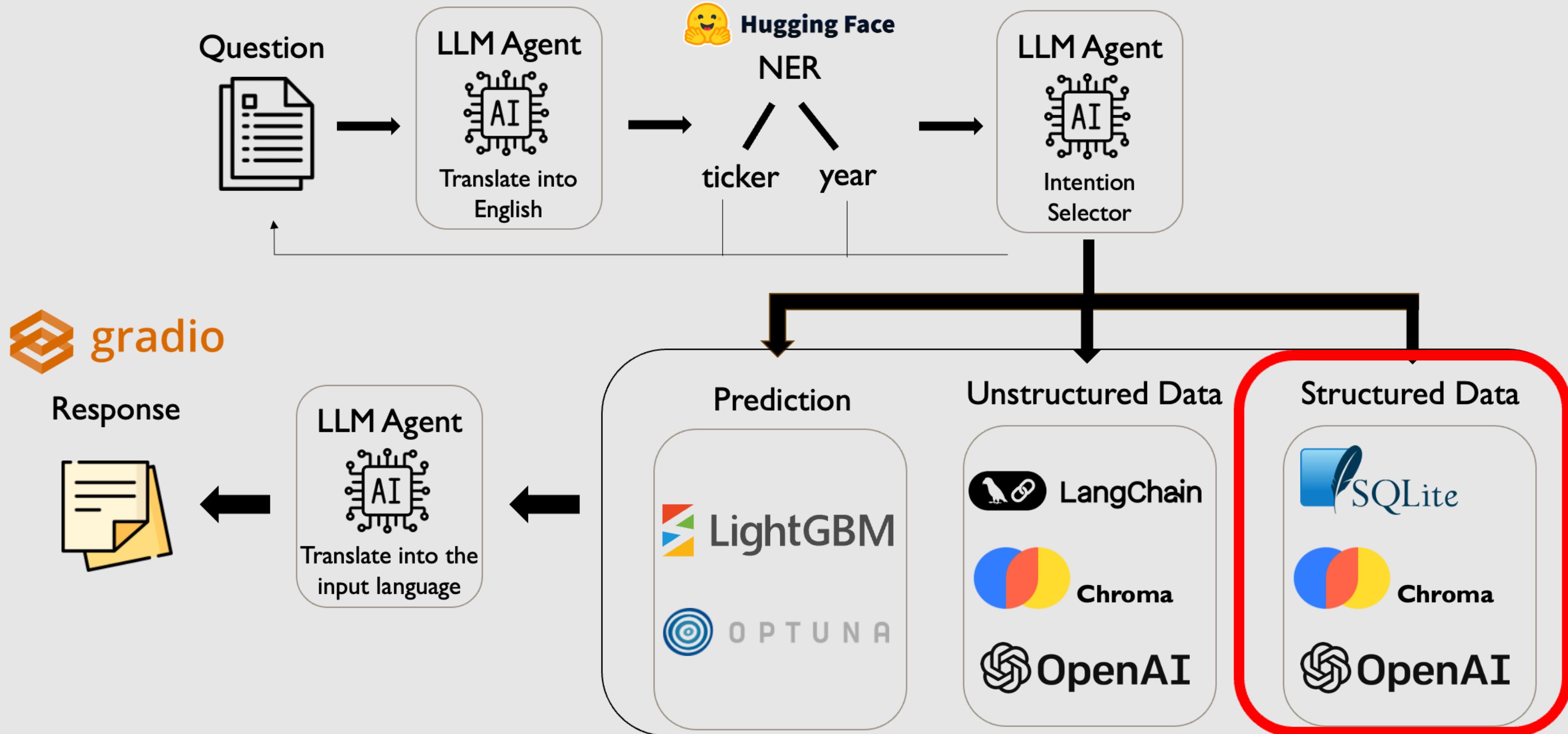
NORP	affiliation
ORDINAL	ordinal value
ORG	organization name
PERCENT	percent value
PERSON	person name
PRODUCT	product name
QUANTITY	quantity value
TIME	time value
WORK_OF_ART	name of work of art



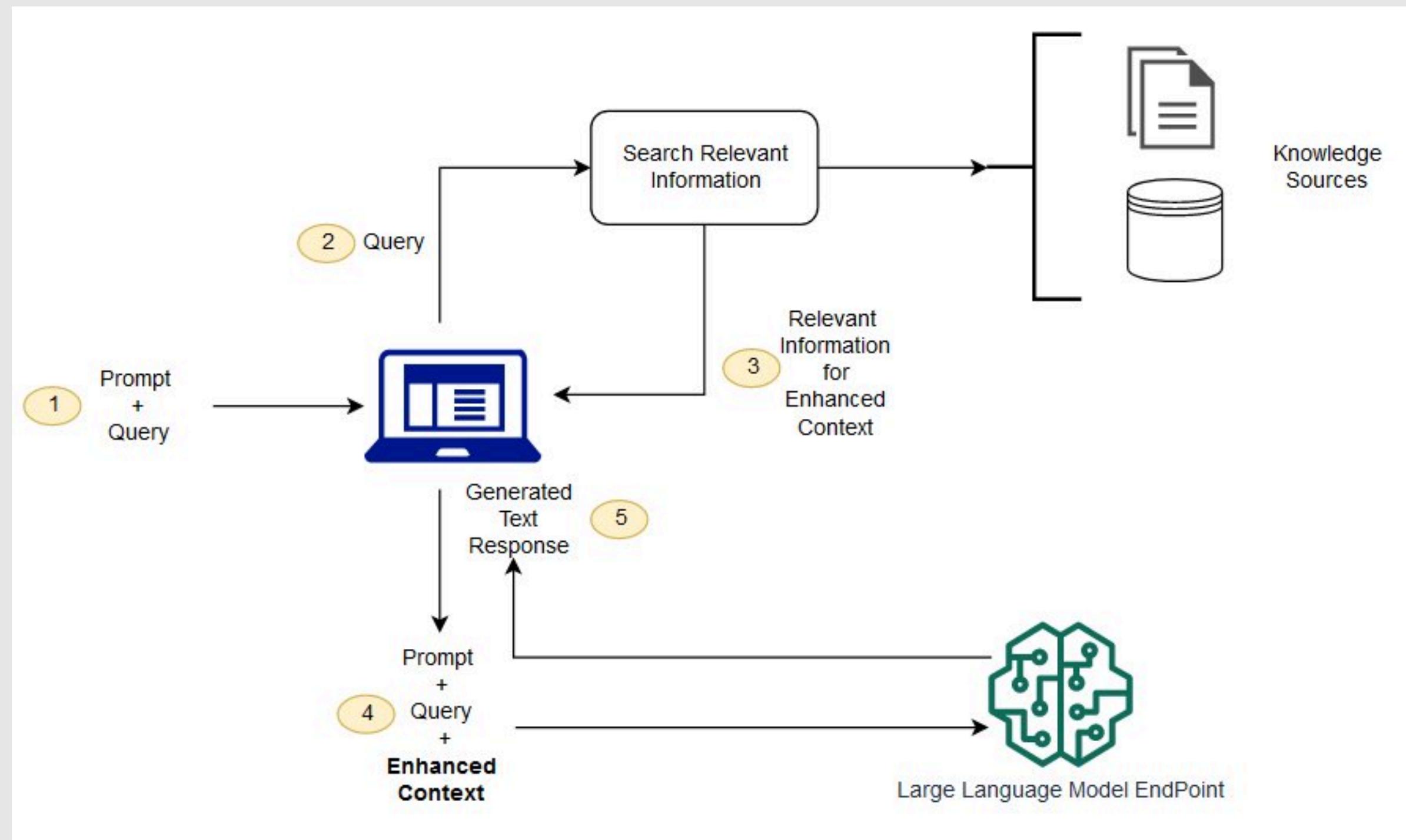
PART 2

STRUCTURED/ UNSTRUCTURED DATA

Structured Data Retrieval -> Chroma + SQL
Unstructured Data Retrieval -> Chroma+neo4j

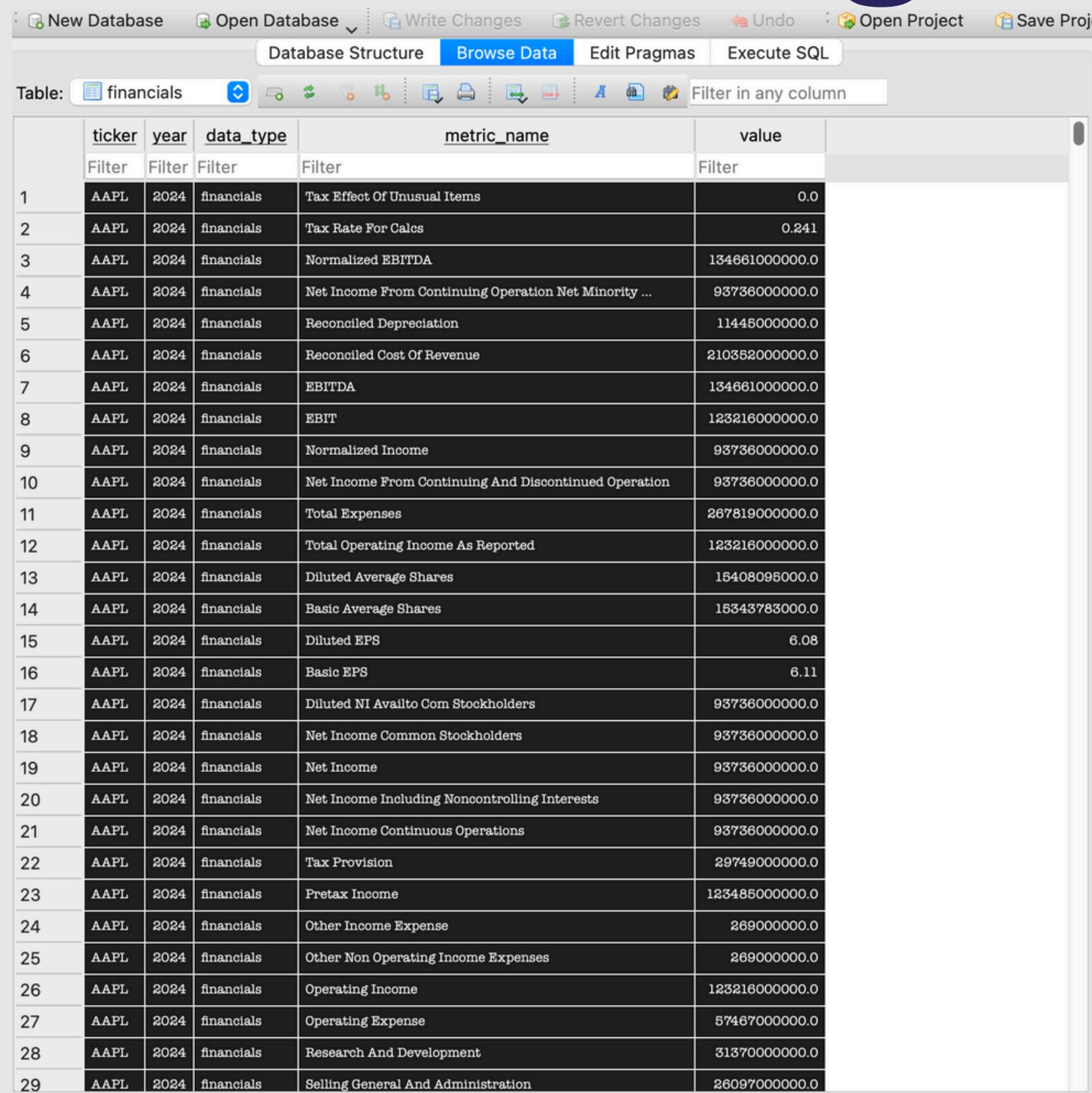


Retrieval Augmented Generation



SOURCES: AWS

Structured Knowledge Sources



The screenshot shows a database interface with a toolbar at the top containing 'New Database', 'Open Database', 'Write Changes', 'Revert Changes', 'Undo', 'Open Project', and 'Save Project'. Below the toolbar is a menu bar with 'Database Structure' (selected), 'Browse Data', 'Edit Pragmas', and 'Execute SQL'. A 'Table' dropdown is set to 'financials'. The main area displays a table with the following data:

	ticker	year	data_type	metric_name	value
1	AAPL	2024	financials	Tax Effect Of Unusual Items	0.0
2	AAPL	2024	financials	Tax Rate For Calcs	0.241
3	AAPL	2024	financials	Normalized EBITDA	134661000000.0
4	AAPL	2024	financials	Net Income From Continuing Operation Net Minority ...	93736000000.0
5	AAPL	2024	financials	Reconciled Depreciation	11445000000.0
6	AAPL	2024	financials	Reconciled Cost Of Revenue	210352000000.0
7	AAPL	2024	financials	EBITDA	134661000000.0
8	AAPL	2024	financials	EBIT	123216000000.0
9	AAPL	2024	financials	Normalized Income	93736000000.0
10	AAPL	2024	financials	Net Income From Continuing And Discontinued Operation	93736000000.0
11	AAPL	2024	financials	Total Expenses	267819000000.0
12	AAPL	2024	financials	Total Operating Income As Reported	123216000000.0
13	AAPL	2024	financials	Diluted Average Shares	15408095000.0
14	AAPL	2024	financials	Basic Average Shares	15343783000.0
15	AAPL	2024	financials	Diluted EPS	6.08
16	AAPL	2024	financials	Basic EPS	6.11
17	AAPL	2024	financials	Diluted NI Availto Com Stockholders	93736000000.0
18	AAPL	2024	financials	Net Income Common Stockholders	93736000000.0
19	AAPL	2024	financials	Net Income	93736000000.0
20	AAPL	2024	financials	Net Income Including Noncontrolling Interests	93736000000.0
21	AAPL	2024	financials	Net Income Continuous Operations	93736000000.0
22	AAPL	2024	financials	Tax Provision	29749000000.0
23	AAPL	2024	financials	Pretax Income	123485000000.0
24	AAPL	2024	financials	Other Income Expense	269000000.0
25	AAPL	2024	financials	Other Non Operating Income Expenses	269000000.0
26	AAPL	2024	financials	Operating Income	123216000000.0
27	AAPL	2024	financials	Operating Expense	57467000000.0
28	AAPL	2024	financials	Research And Development	31370000000.0
29	AAPL	2024	financials	Selling General And Administration	26097000000.0

IMPLEMENTATION

Scopes: Nasdaq-100

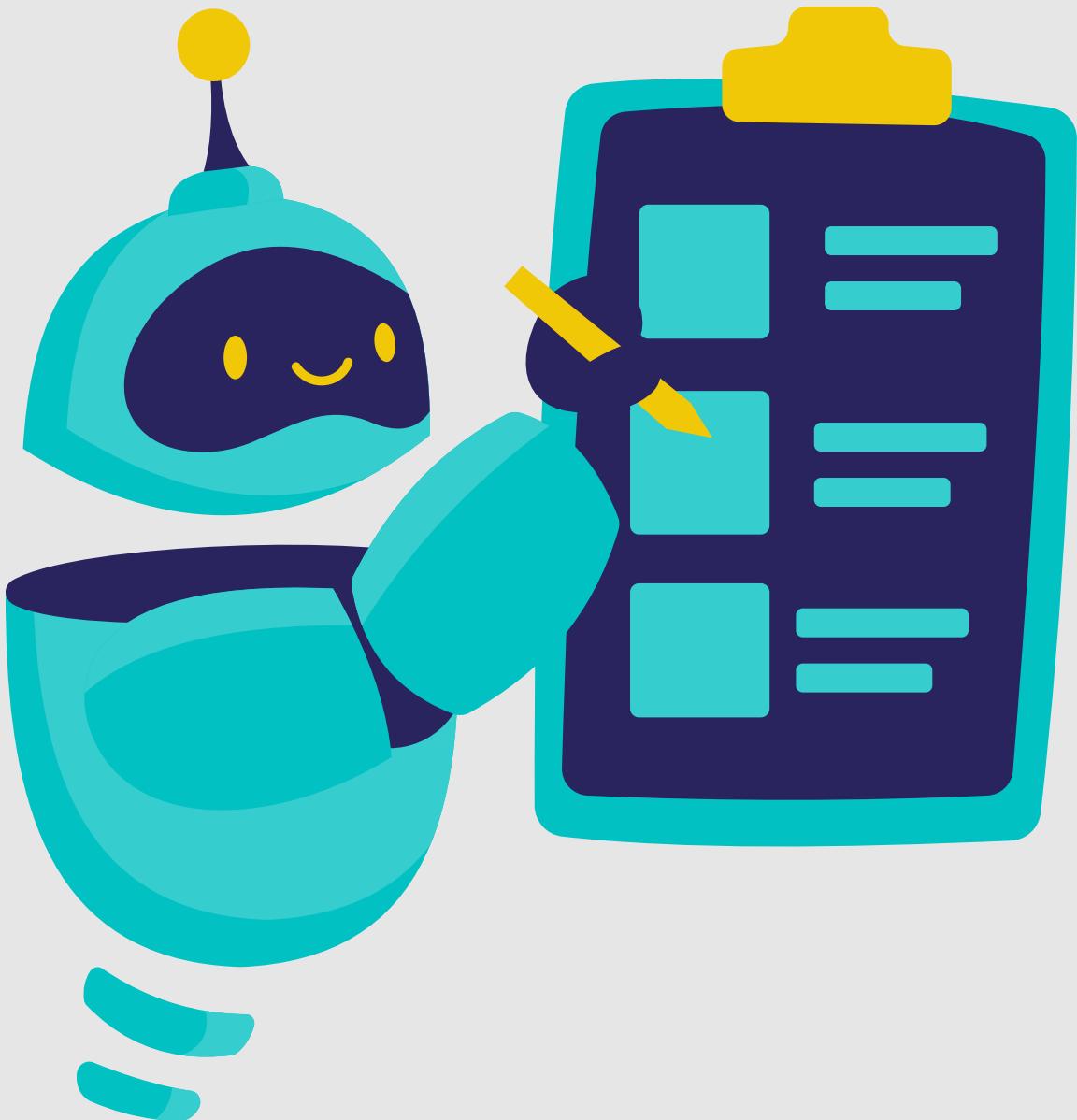
- Financials:
Balance Sheets, Cash Flow Statements, Income Statements

Data Frequency: Annual (2021~2024)

Sources: SEC EDGAR, Yahoo Finance API

Retrieval: System finds relevant SQL metrics based on user queries.

Generation: LLM produces responses grounded in retrieved company information.



Results

Chatbot

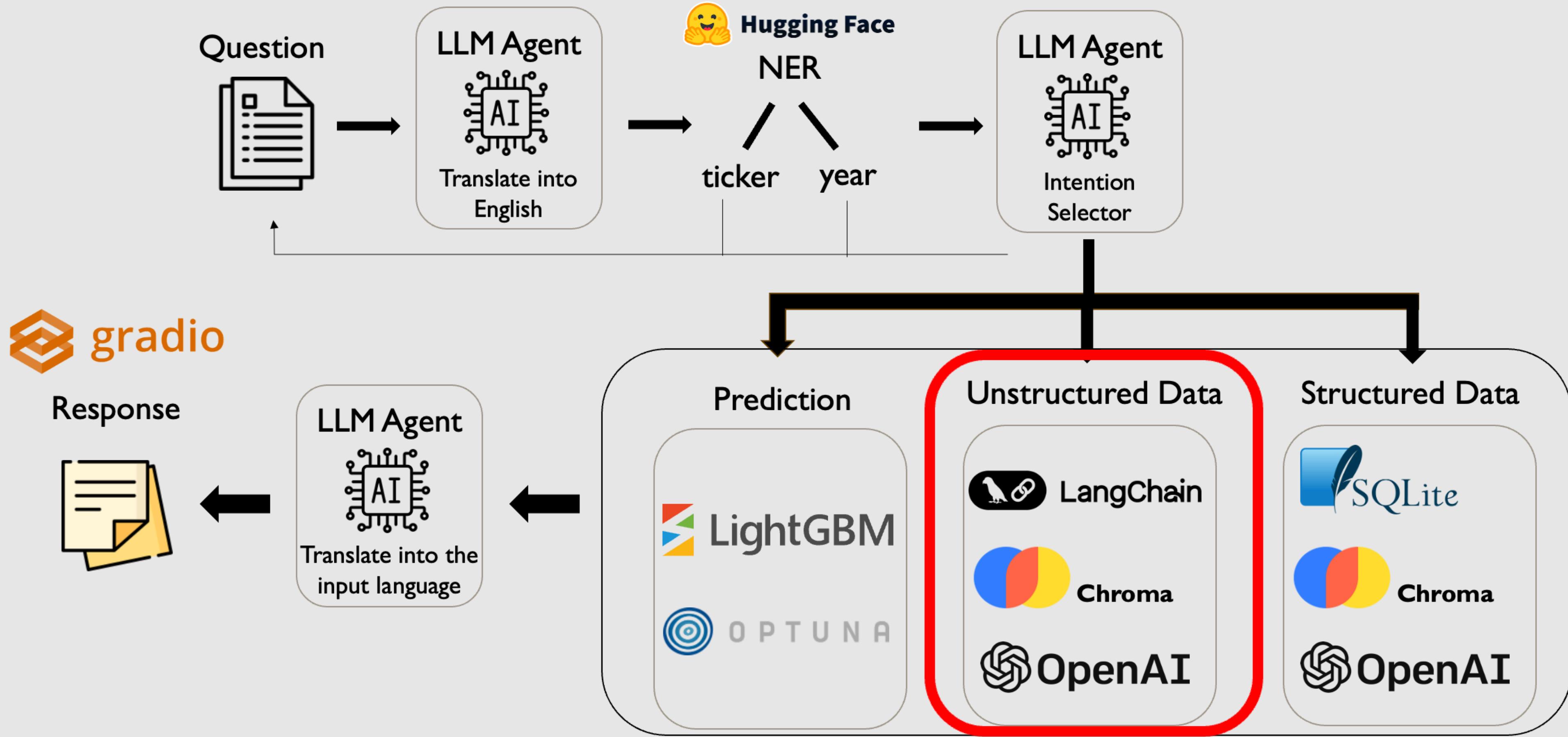
Apple's revenue in 2023 was \$383,285,000,000.

Do you have any other questions I can help with?

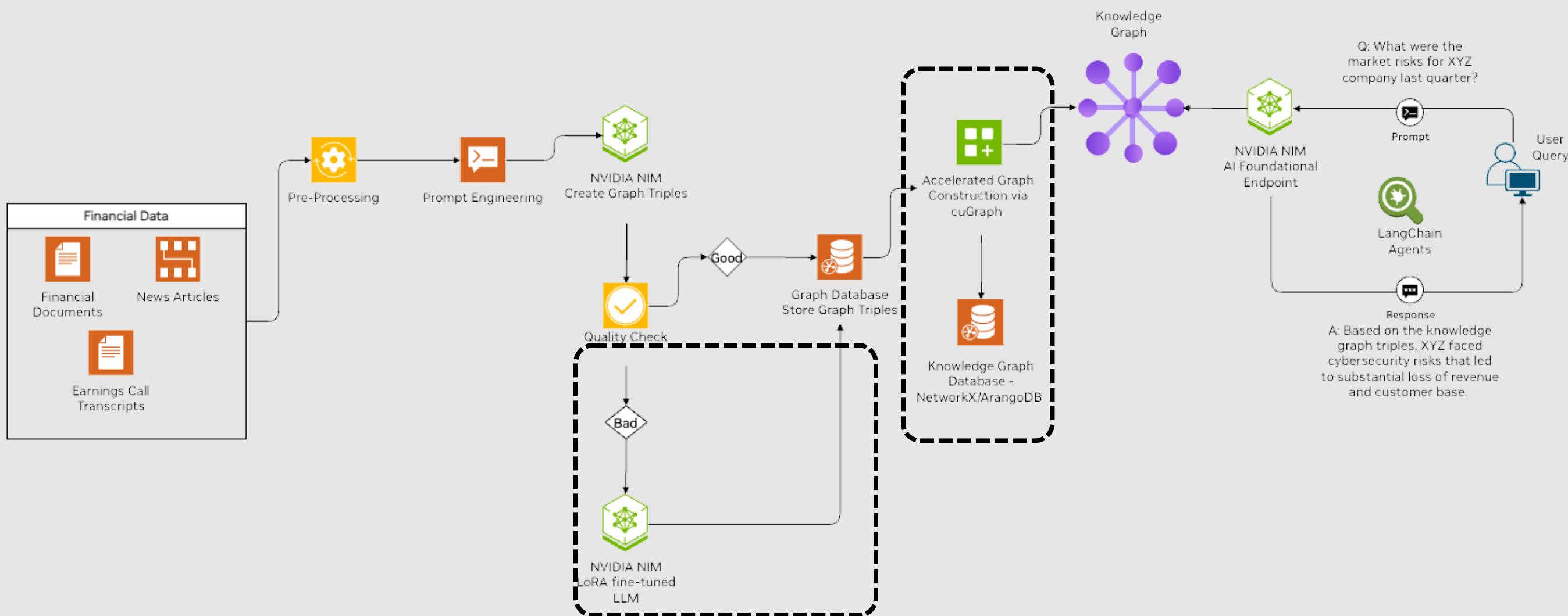
What was Apple's revenue in 2023?

```
1 SELECT ticker, year, data_type, metric_name, value  
2 FROM financials  
3 WHERE ticker = "AAPL"  
4 AND year = "2023"  
5 AND metric_name = "Total Revenue";  
6
```

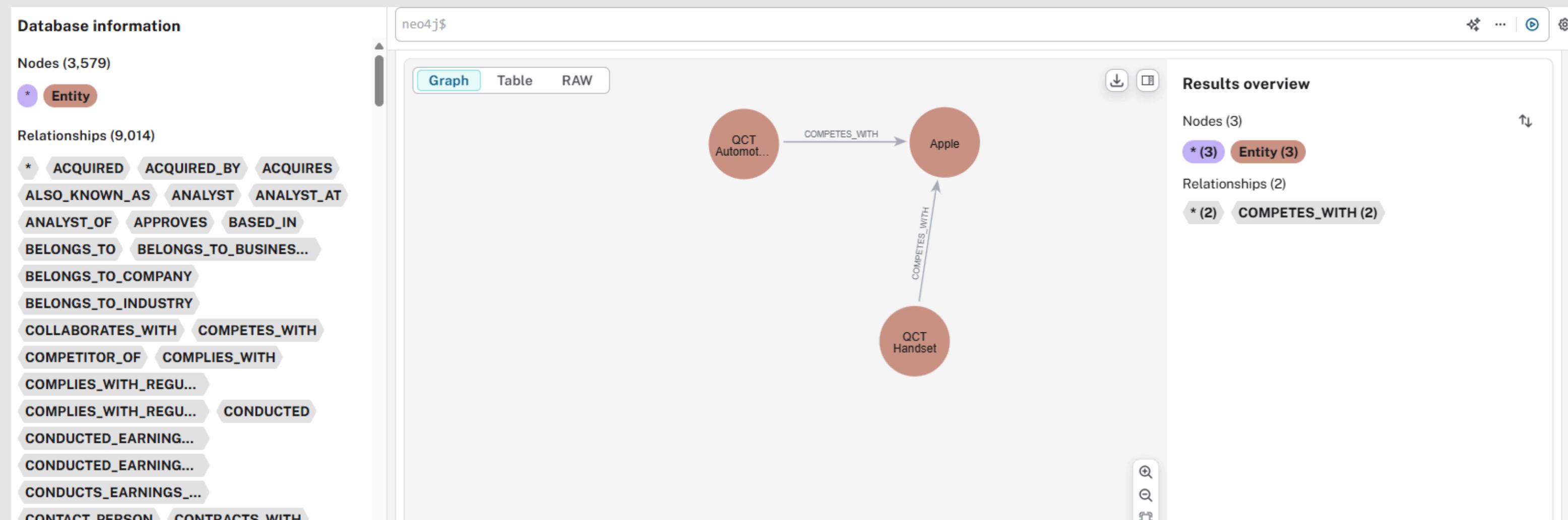
	ticker	year	data_type	metric_name	value	
1	AAPL	2023	financials	Total Revenue	383285000000.0	



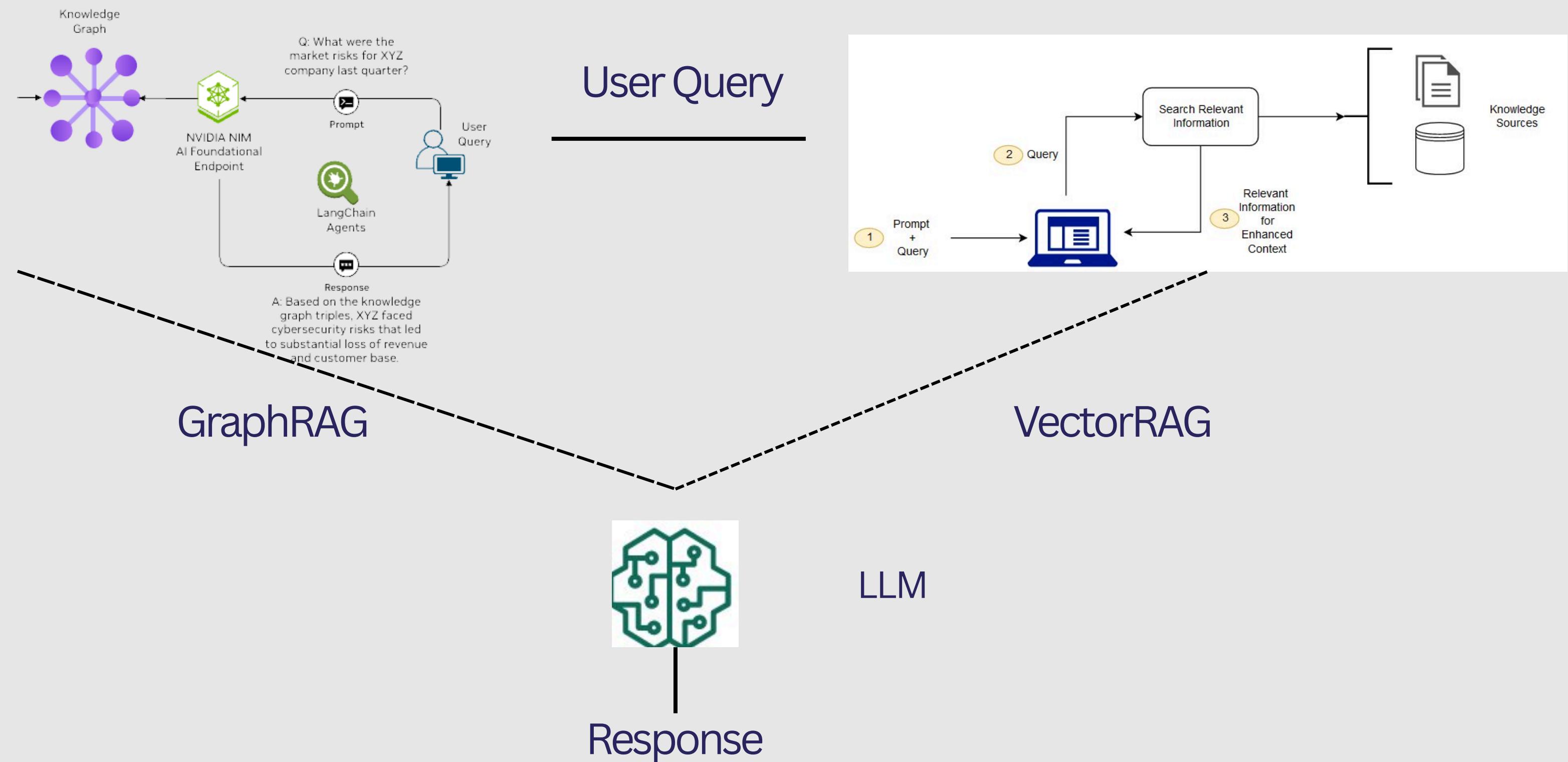
GraphRAG



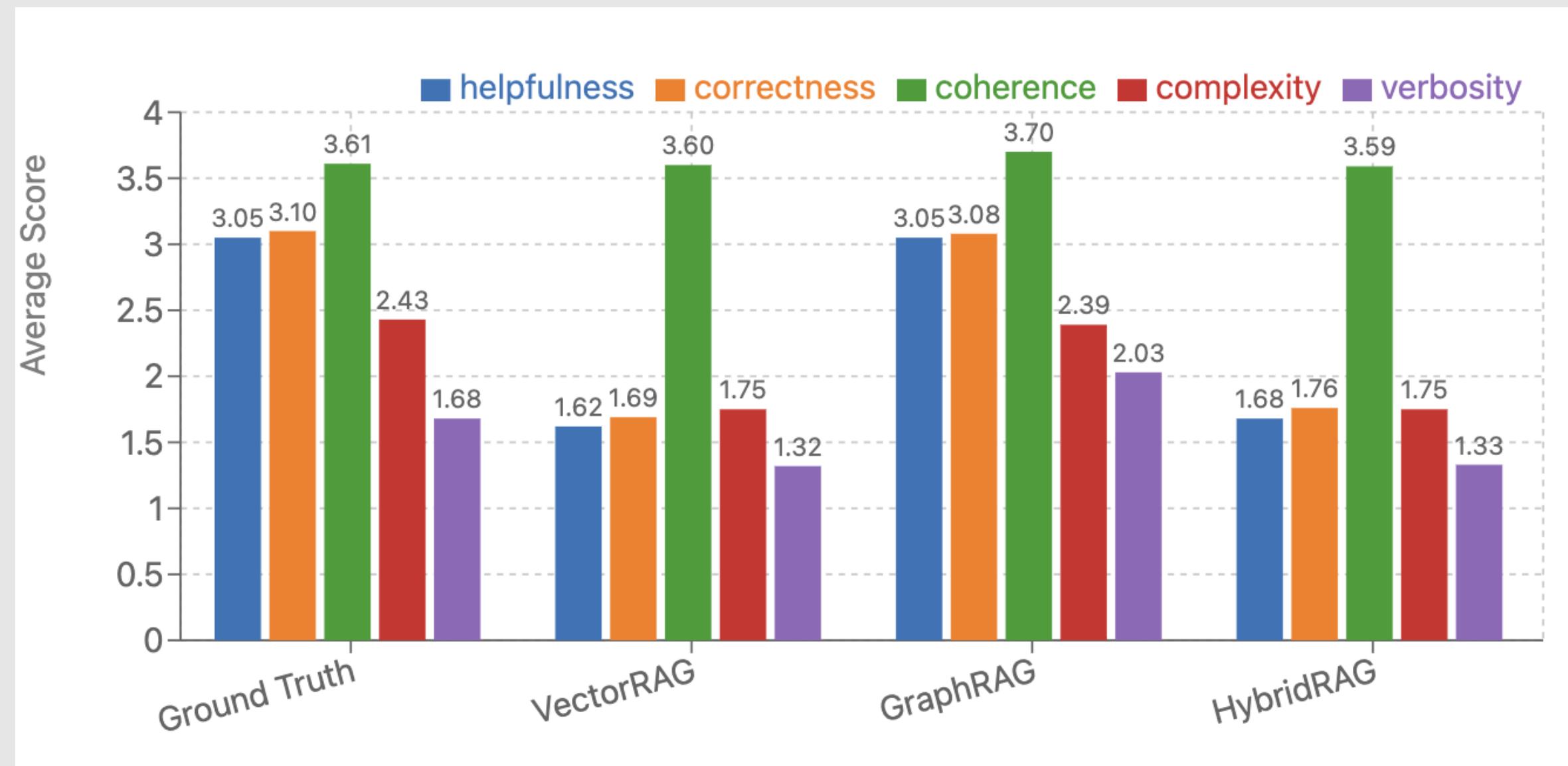
Knowledge Graph



HybridRAG



HybridRAG



IMPLEMENTATION

Scopes: Nasdaq-100

- Documents: 10-Ks, Earnings Transcript

Data Frequency: Annual (2020~2024)

Sources: SEC EDGAR, Companies

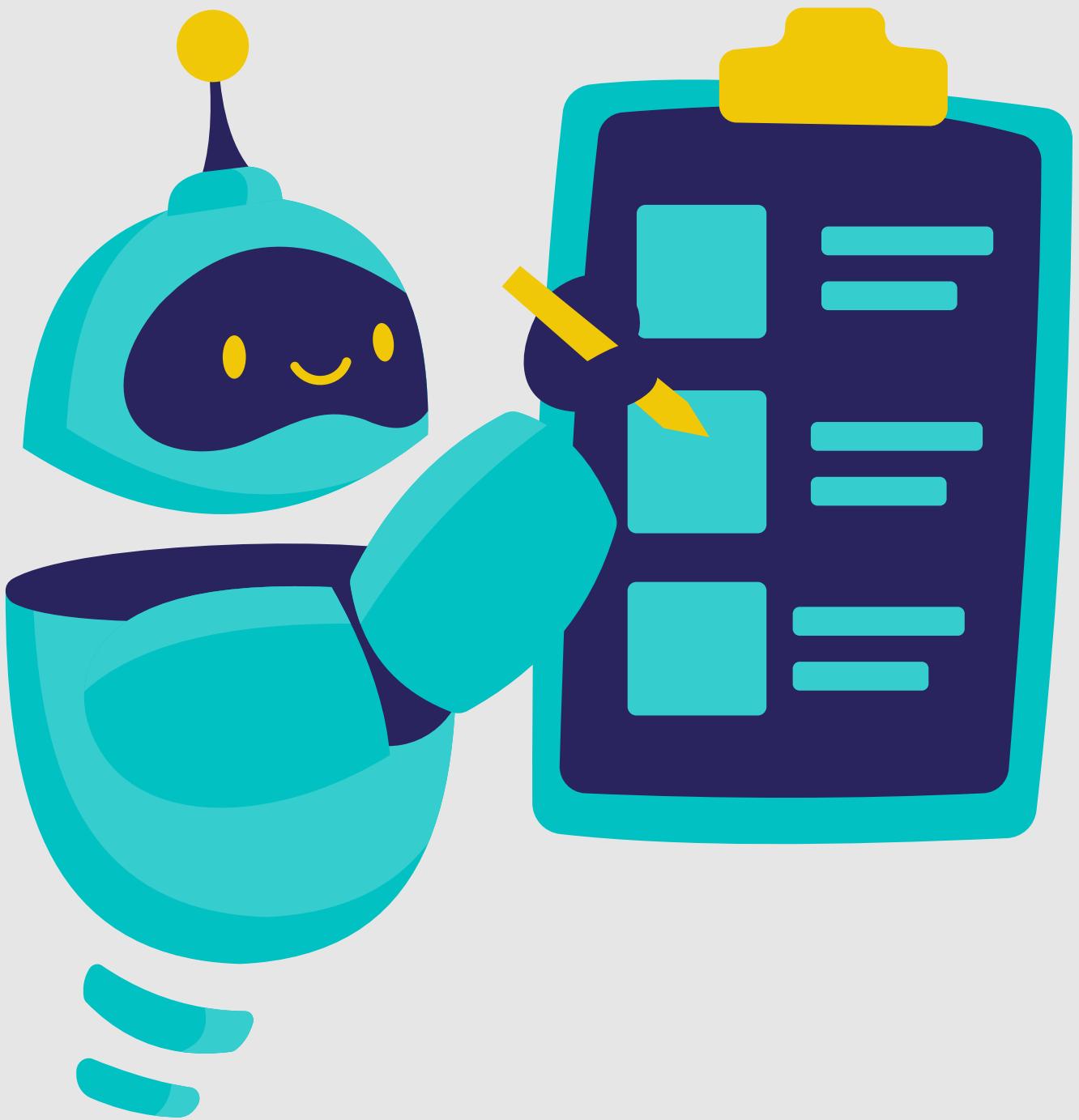
Text Embedding Model: OpenAI's "text-embedding-ada-002"

Re-ranking Model: HuggingFace's 'cross-encoder/ms-marco-MiniLM-L-6-v2'

Retrieval: System finds relevant document sections based on:

- Similarity search and re-ranking model
- Graph search results from cyphered user query

Generation: LLM produces responses grounded in retrieved company information.



Results

Please tell me Apple's revenue recognition policy.

Apple Inc. recognizes revenue at the amount to which it expects to be entitled when control of the products or services is transferred to its customers. Control is typically transferred when the Company has a present right to payment and title and the significant risks and rewards of ownership of products or services are transferred to its customers. For most of the Company's Products net sales, control transfers when products are shipped, while for Services net sales, control transfers over time as services are delivered. Payment for Products and Services net sales is collected within a short period following transfer of control or commencement of delivery of services.

Do you have any other questions I can help with?

What about Apple's business model?

Based on the provided context, Apple's business model focuses on designing, manufacturing, and marketing a wide range of products such as smartphones, personal computers, tablets, wearables, and accessories, as well as offering related services. Apple heavily relies on its ability to introduce innovative new products and services to the marketplace in order to remain competitive. The company controls the integration of offerings, including travel services, into its mobile operating system, and has significant market share in the smartphone market. Additionally, Apple faces substantial competition in various markets, requiring them to continuously improve their products and services to effectively compete.

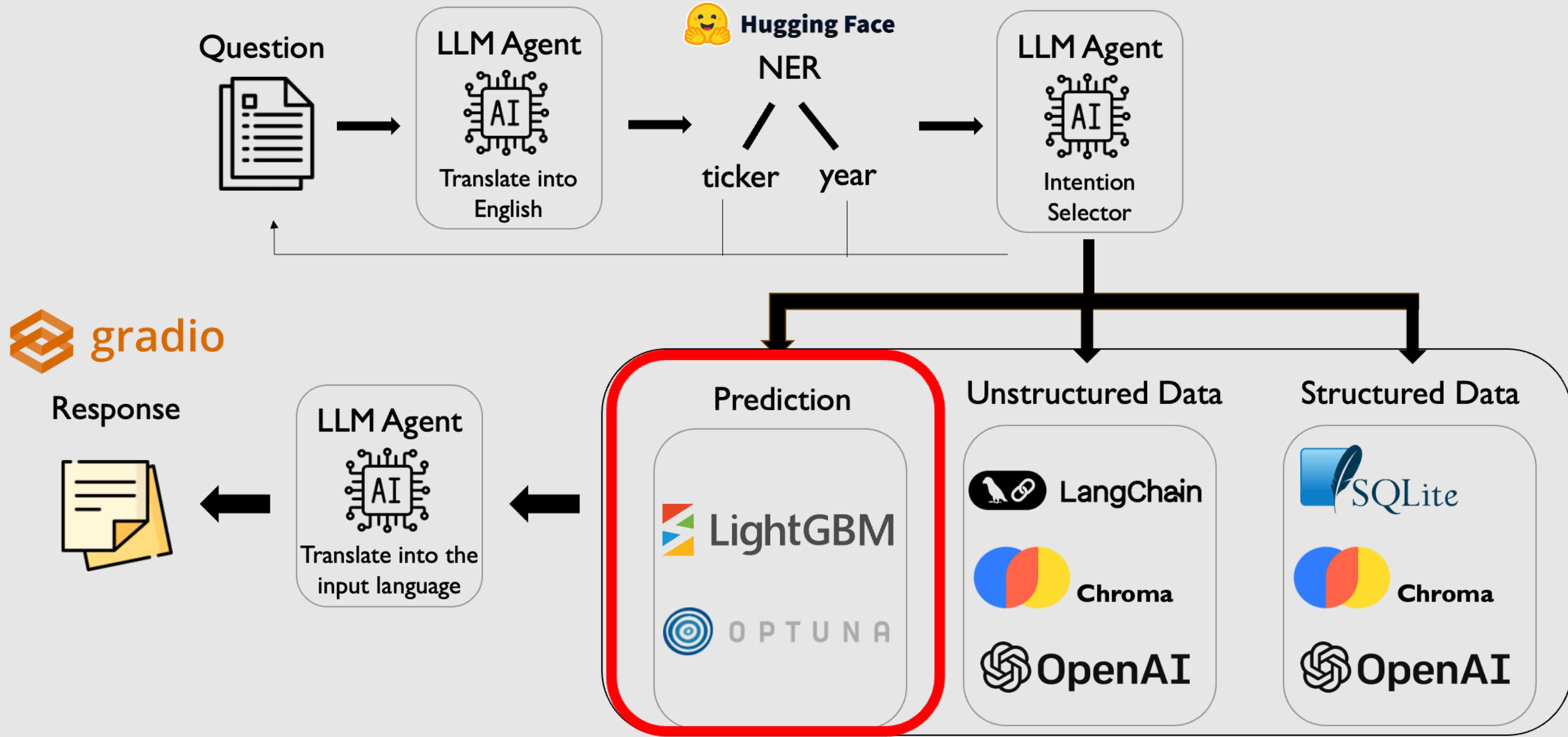
Do you have any other questions I can help with?

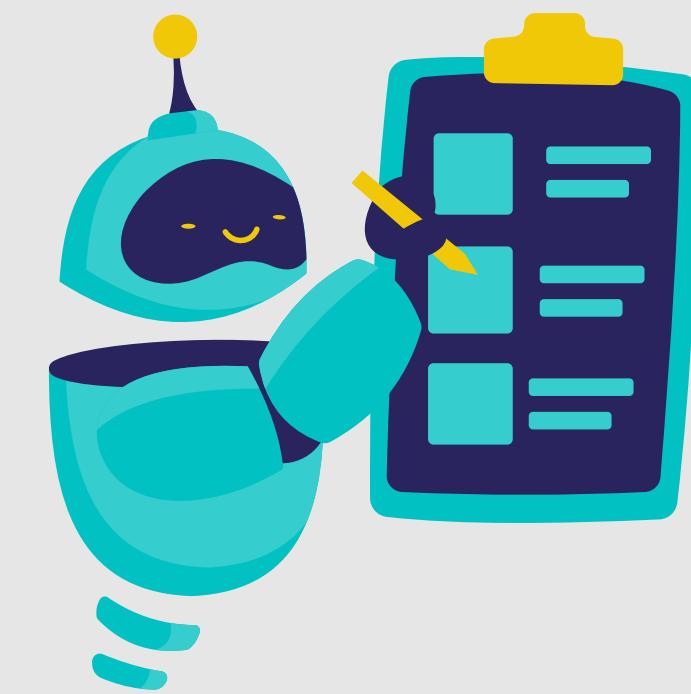
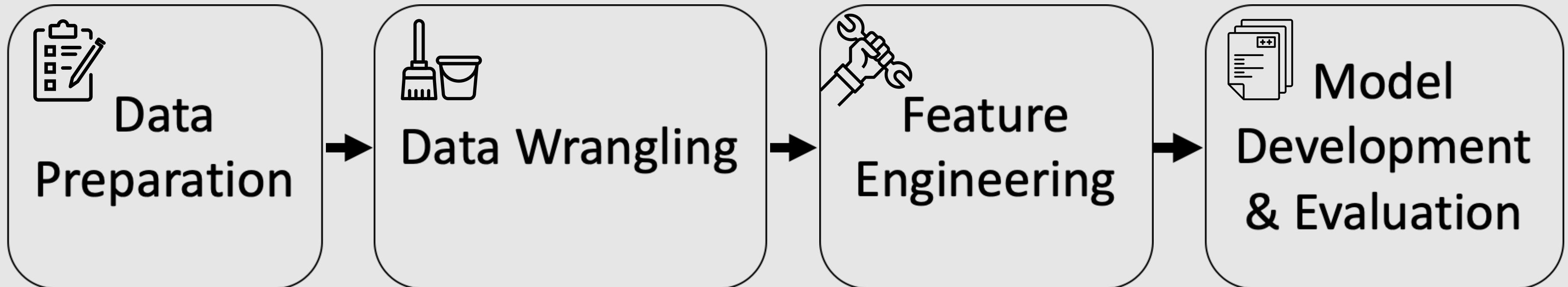


PART 4

PREDICTION

Outperform or Underperform the Market(NASDAQ 100) in Long Term- LightGBM





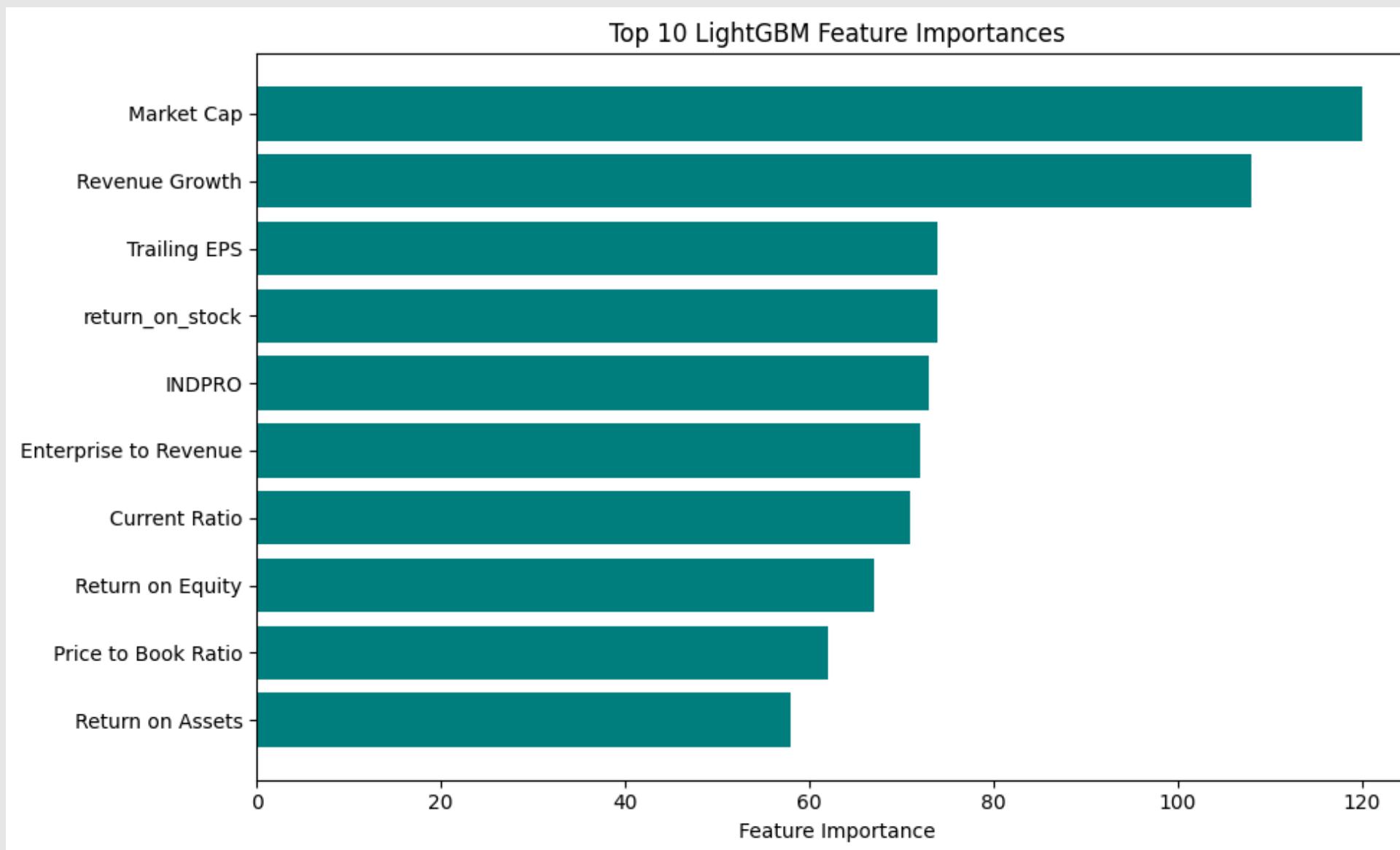
DATA PREPARATION

Features X:

- Firms' financial variables
- Macroeconomic variables

Target Y:

- 0: Underperform the market
- 1: Outperform the market



Frequency: Annual (2010~2024)

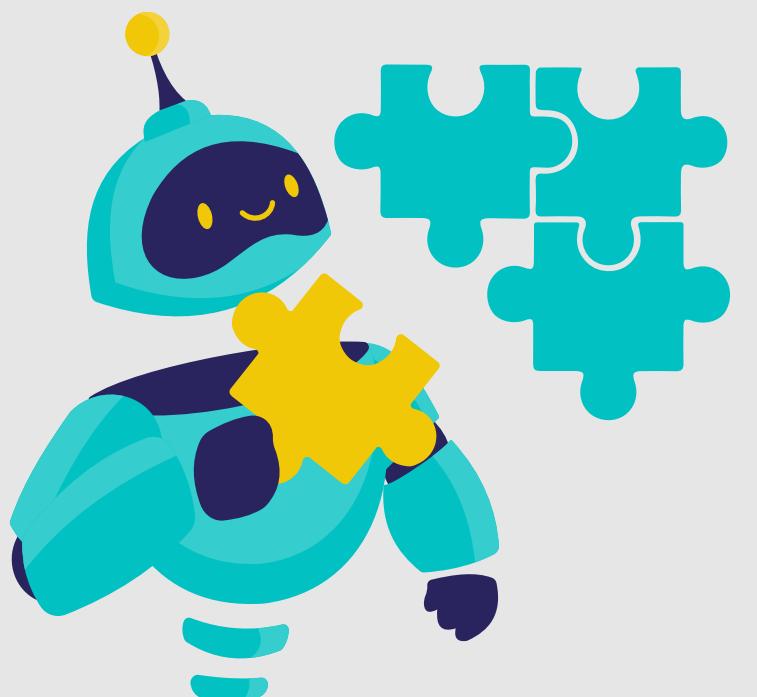
Data resources: Yahoo Finance,
Bloomberg, FRED



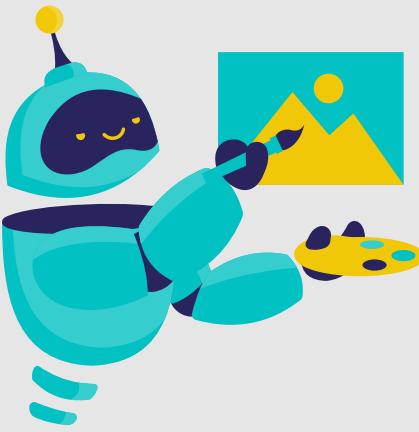
DATA CLEANING

Complete missing values

- Method :
 - KNN (K-Nearest Neighbors)
- Advantages :
 - suitable for financial value data
 - estimation for reasonable missing values by finding K nearest neighbors

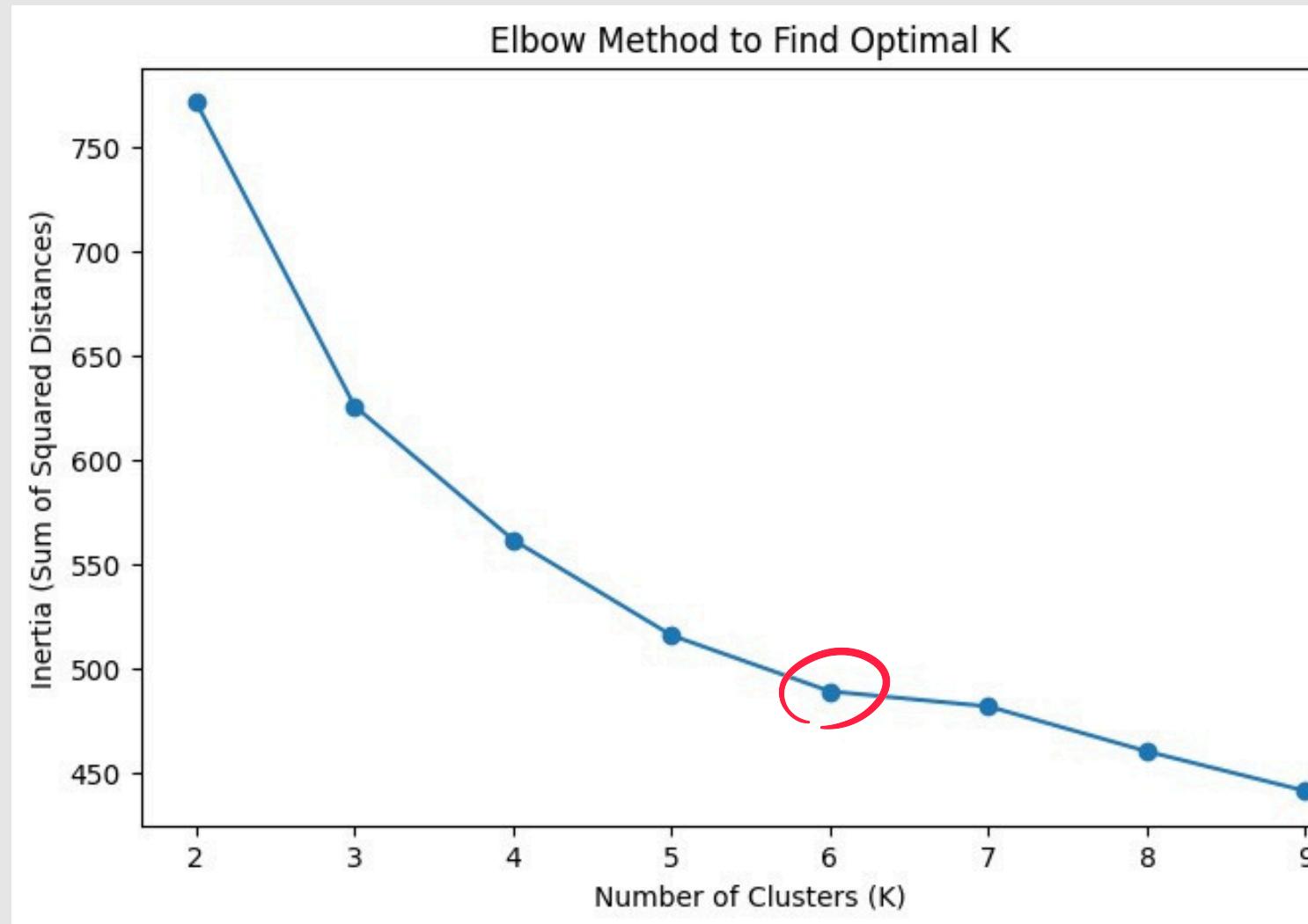


FEATURE ENGINEERING

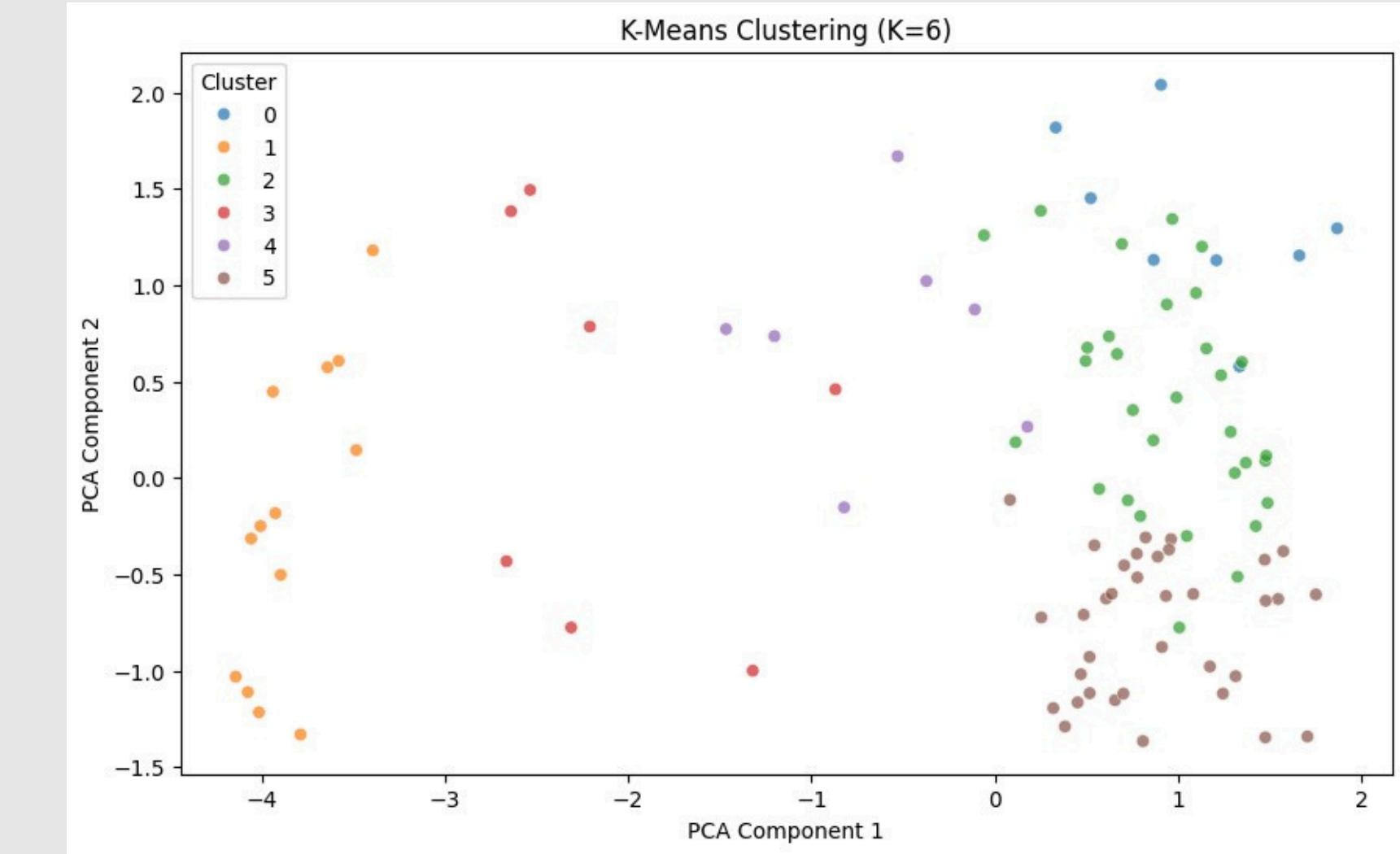


Clustering

- Method:
 - k-means clustering ($k=6$)
- Advantages:
 - Predefined Number of Clusters
 - Capture Natural Patterns



Elbow method to determine optimal k

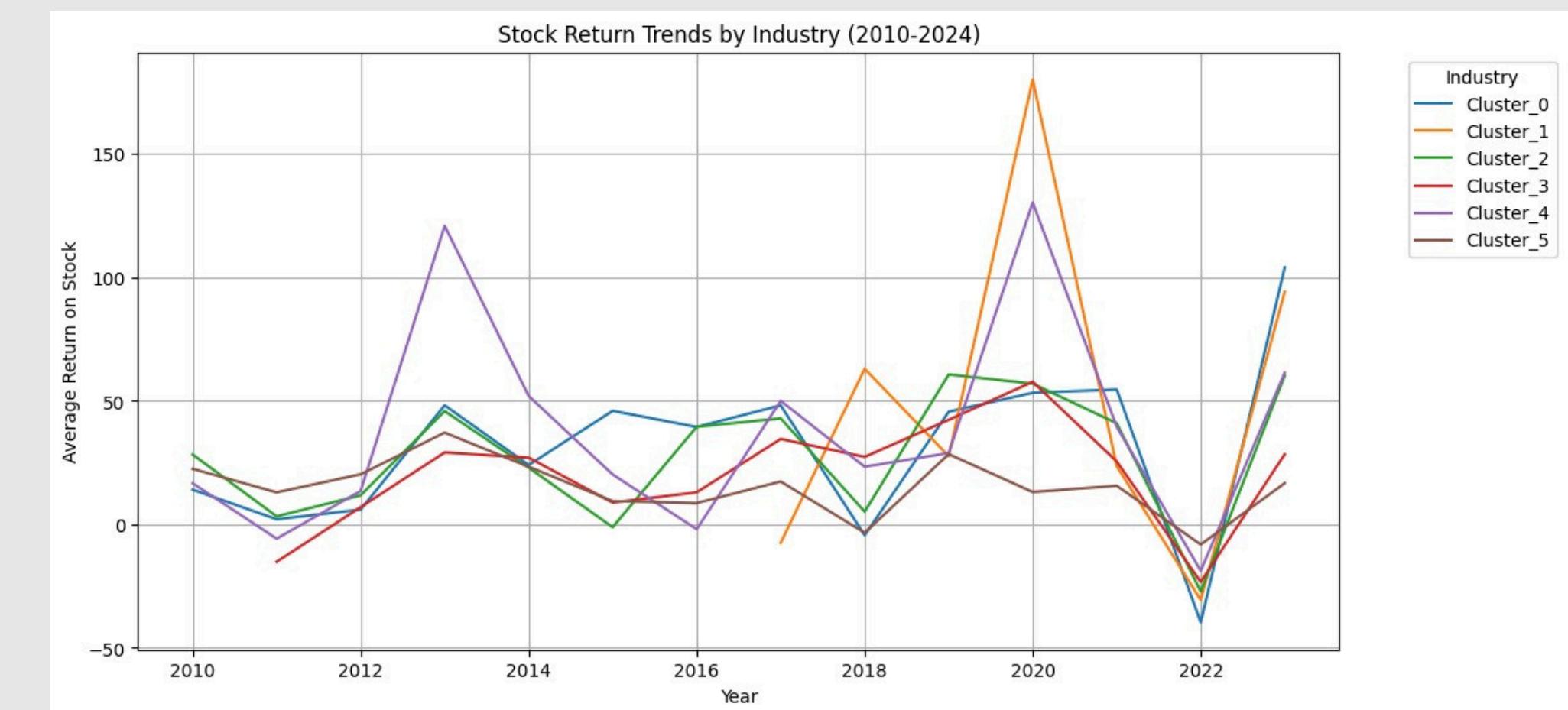
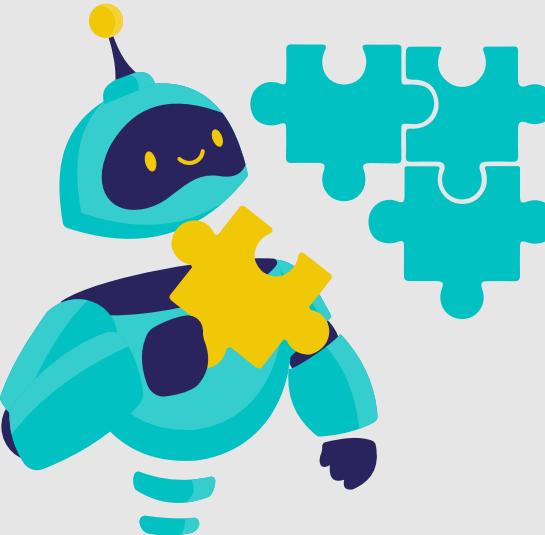


PCA visualization of k-means clustering

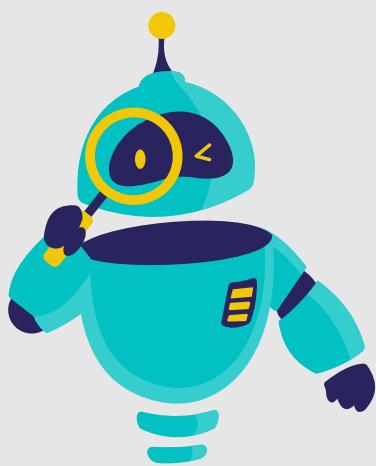
FEATURE TRANSFORMATION

- Financial Features with Three-year Rolling Z-score Transformation:
 - profit margin
 - price to book ratio
- Advantages:
 - flexibly adapt to market changes
 - company's performance relative to the market

- Year sine & cosine:
 - capture cyclical patterns



MODEL DEVELOPMENT



Model: LightGBM

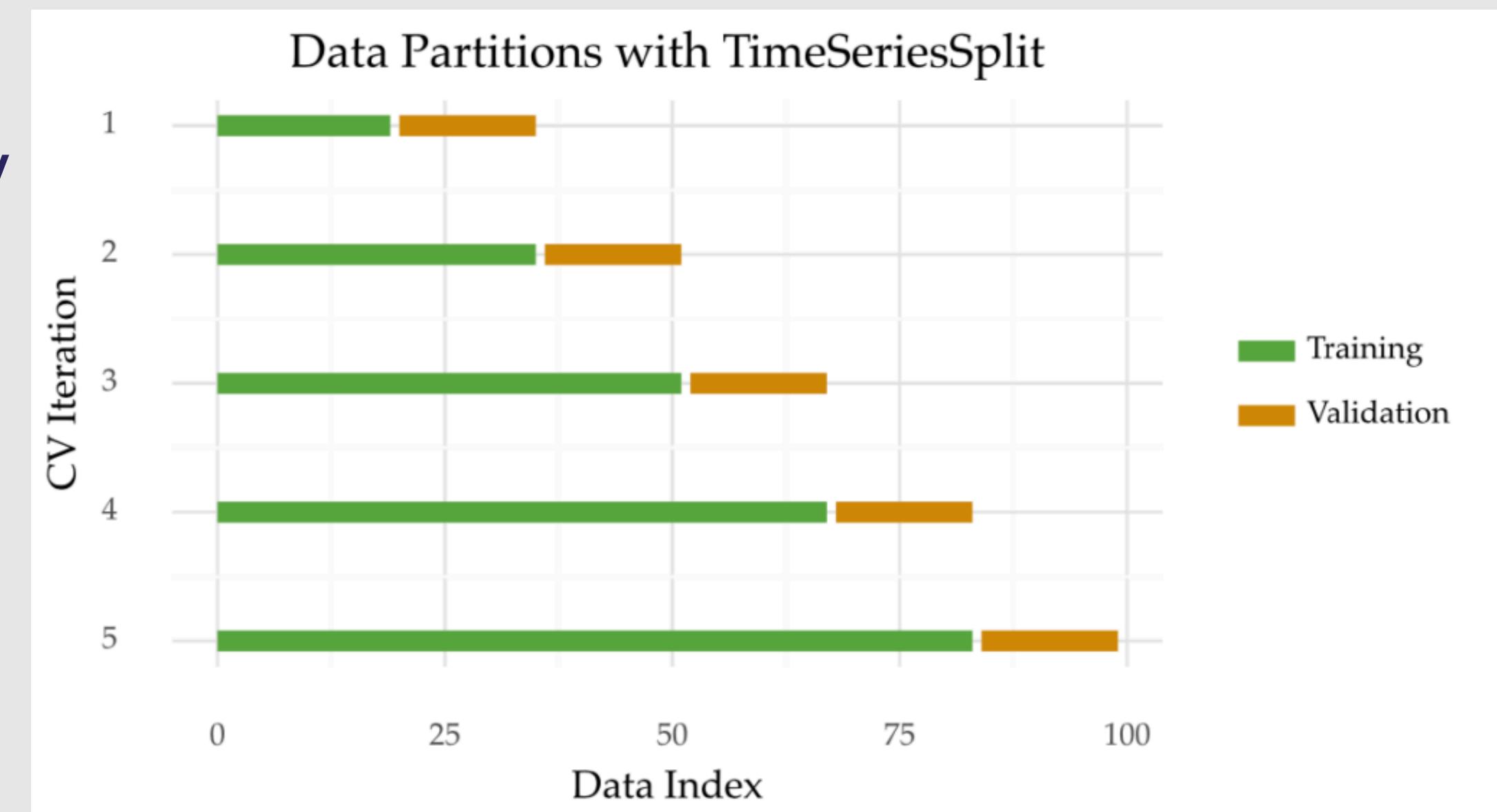
- Structured financial data
- Handles many features efficiently

Validation: TimeSeriesSplit

- Expanding-window CV
- Prevents data leakage

Best parameters:

- Train: 2010–2021
- Test: 2022–2023



MODEL DEVELOPMENT

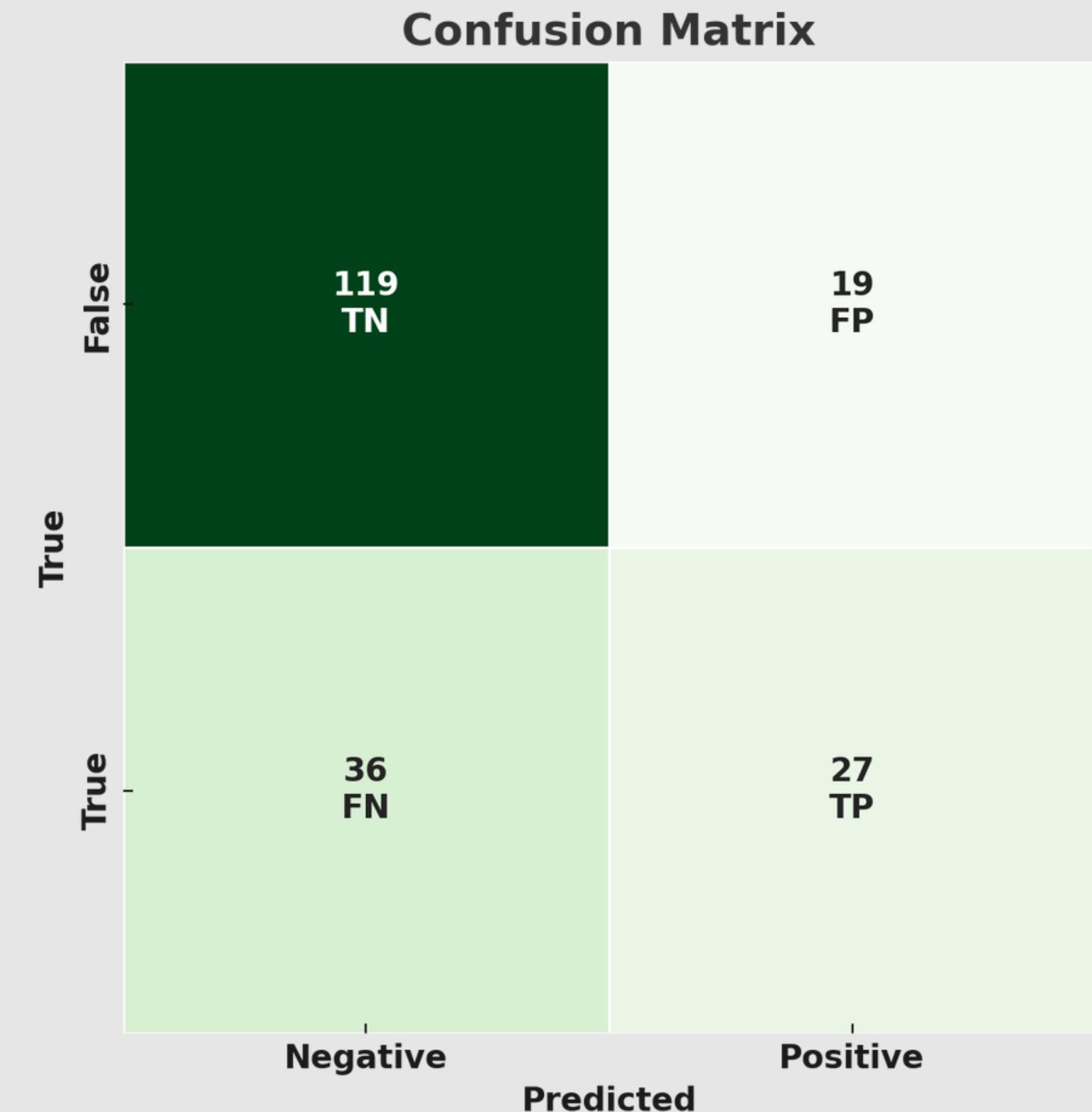
Full Feature Model

F1 Score

- Good for imbalanced data
- Higher \uparrow = better at finding outperformers
- 0.4977

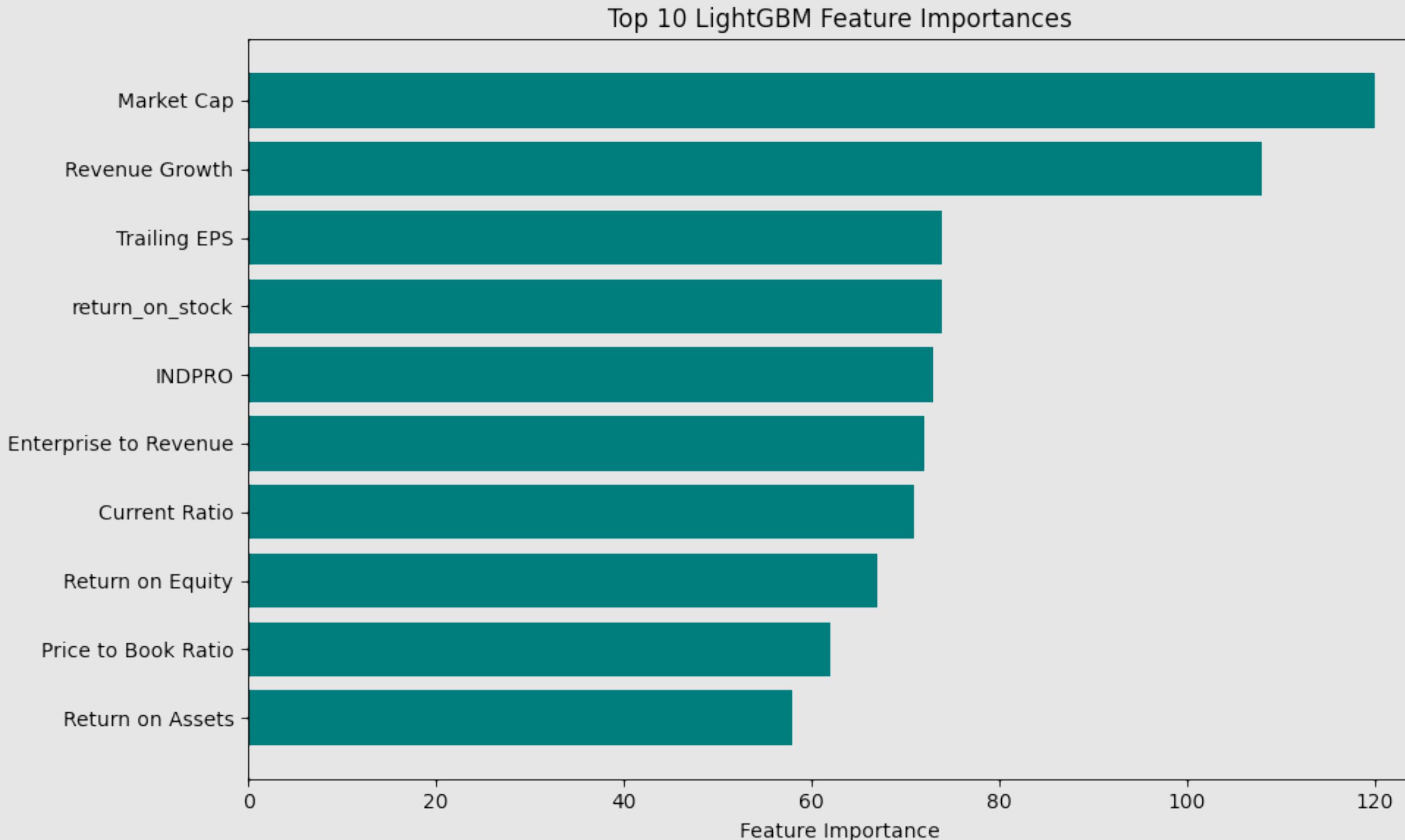
ROC-AUC

- Measures overall model quality
- Higher \uparrow = better separation
- 0.6456



MODEL DEVELOPMENT

LightGBM 模型的特徵重要性排序圖 (Feature Importance Plot)



MODEL DEVELOPMENT

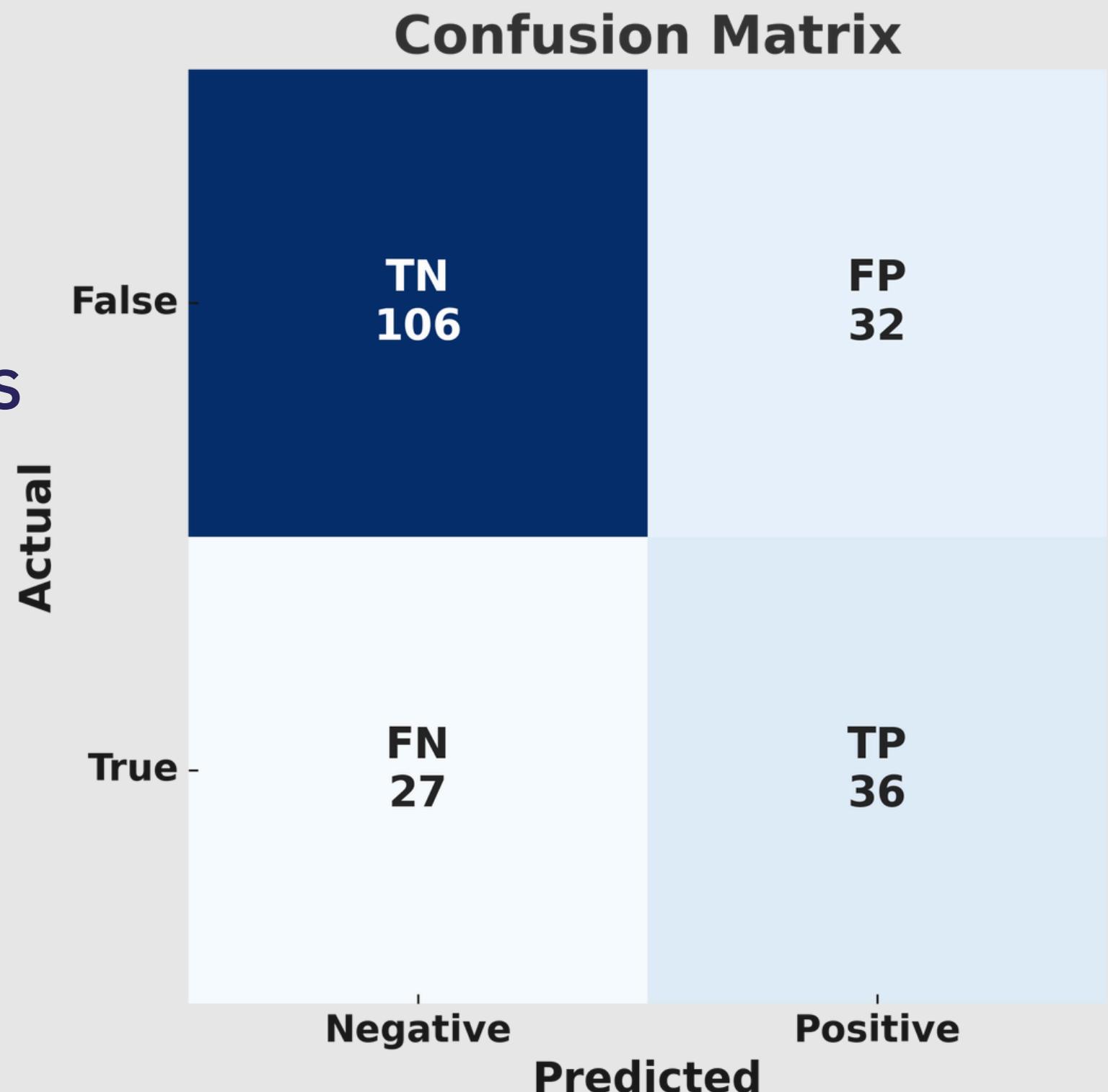
Top Feature Model (LGB Importance)

F1 Score

- Good for imbalanced data
- Higher ↑ = better at finding outperformers
- 0.5486

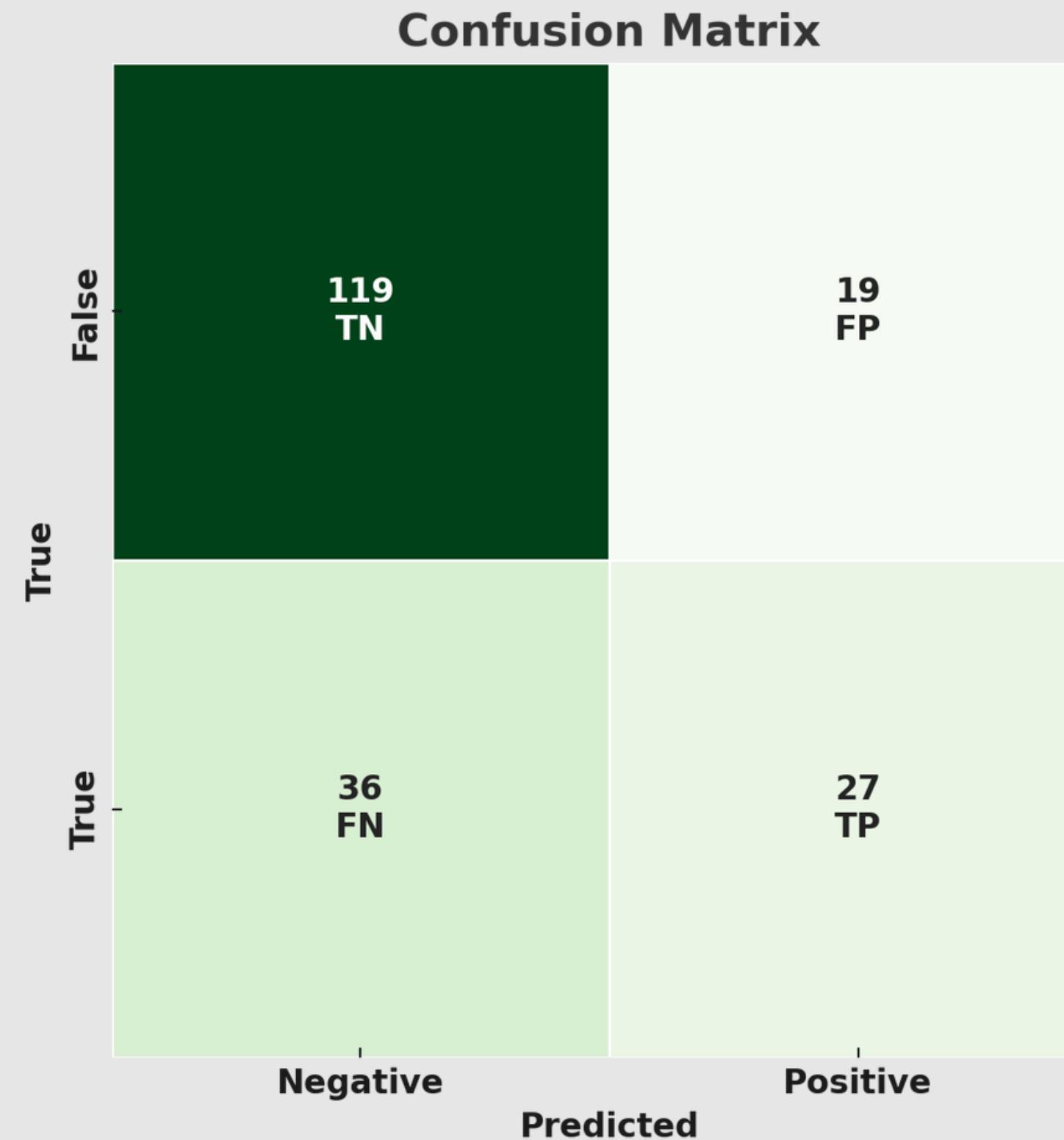
ROC-AUC

- Measures overall model quality
- Higher ↑ = better separation
- 0.6693

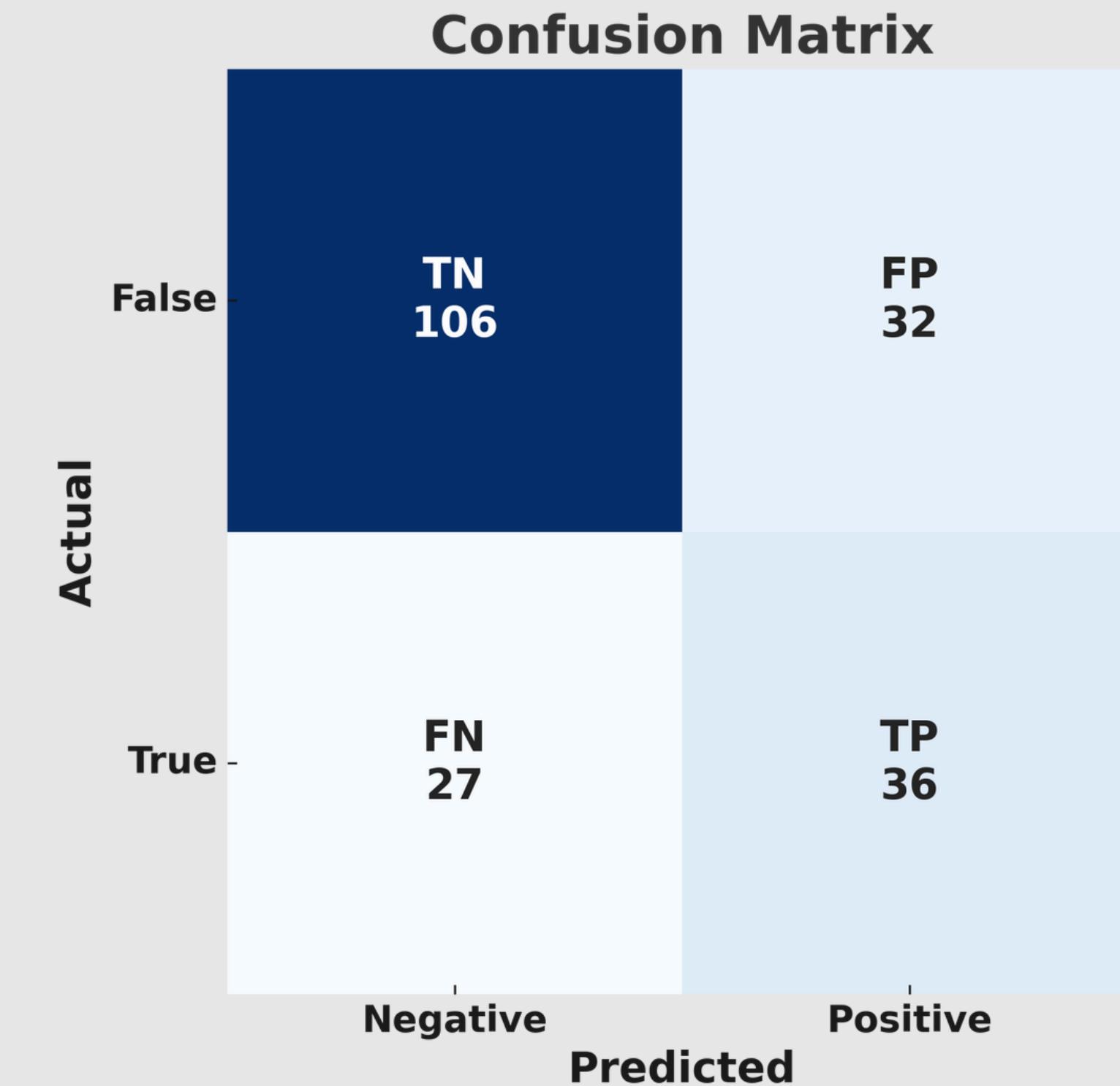


MODEL DEVELOPMENT

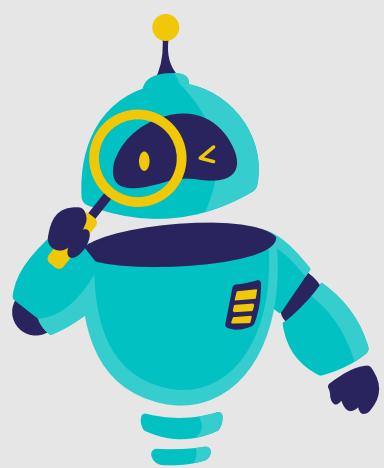
Full Feature Model
AUC: 0.6456, F1: 0.4977



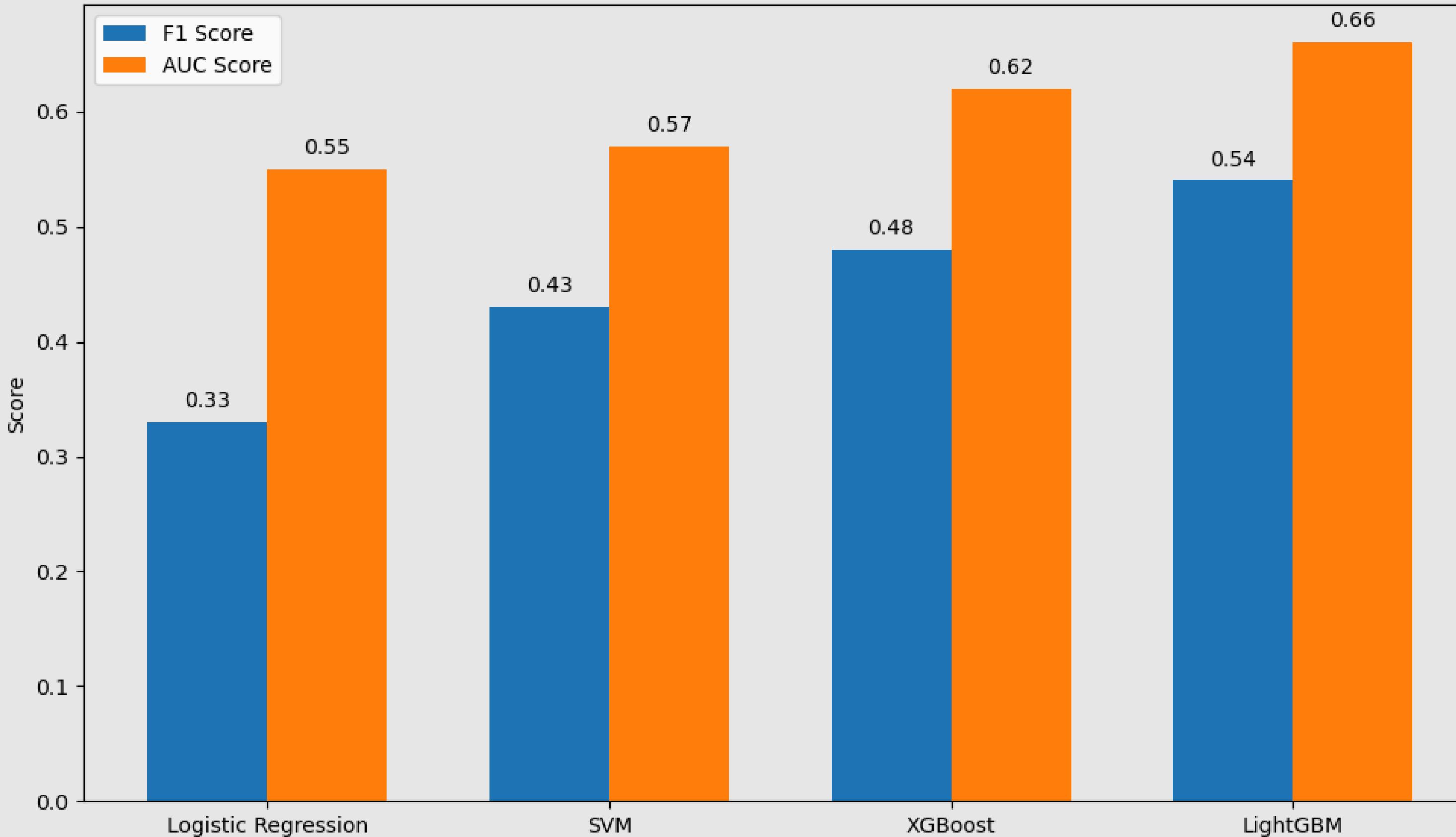
Top Feature Model (LGB Importance)
AUC: 0.6693, F1: 0.5486



BASELINE MODEL



Model Performance Comparison (F1 vs AUC)





GROUP B

THANK YOU

FinScope3D: Data Retrieval x Document Analysis x Data-Driven Prediction

Members: Jay Wu, Ray Chang, Yu-Ting Chen, Ingrid Tseng

Mentor: Jerry Liao, Ti-Wen Chen

Introduction

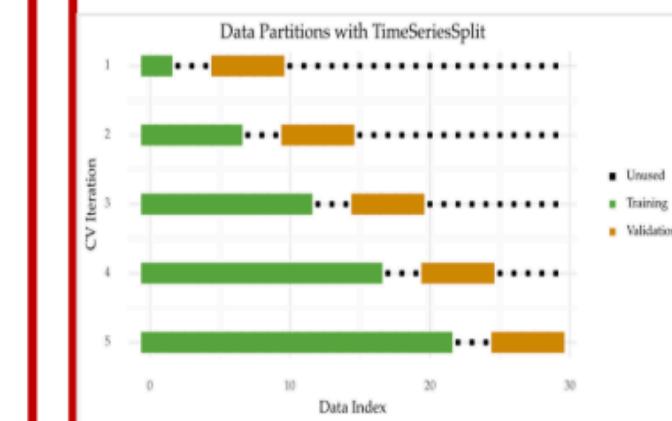
- Financial questions are often complex and require integrating multiple sources like reports, transcripts, and predictions. FinScope3D helps simplify this process.
- From the user's perspective, we aim to extract meaningful entities and understand intent behind financial questions. From the system's perspective, we choose the right model or data to generate precise answers.
- Our system combines NER, structured and unstructured data search, and machine learning predictions—forming a comprehensive financial QA pipeline.



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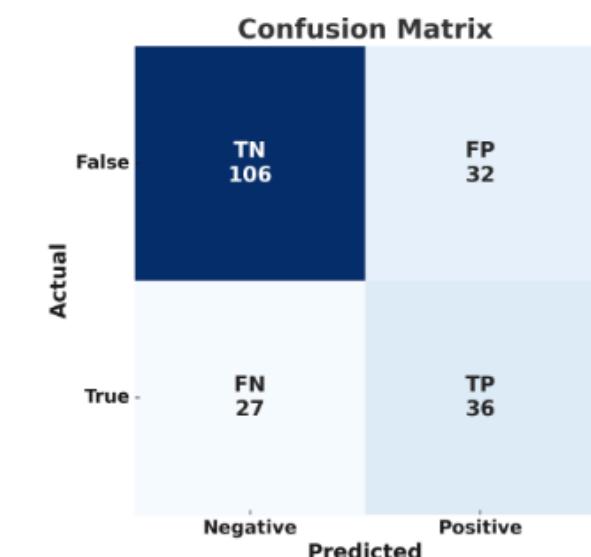
Dataset

- The sources of structured data include SEC EDGAR and the Yahoo Finance API
- The sources of unstructured data include SEC EDGAR and companies
- In the prediction part,
 - firm-specific financial data is obtained from Bloomberg and Yahoo Finance (<https://finance.yahoo.com/>)
 - macroeconomic data is sourced from FRED (<https://fred.stlouisfed.org/>)



Methodology and Results

- We used Named Entity Recognition (NER) to extract key entities (e.g., companies, time, executives, financial metrics, events) from query and earnings transcripts using flair and custom rules. The extracted entities were used to classify query intent or structure into a knowledge graph for enhanced retrieval.
- We implemented HybridRAG by combining vector search for semantic retrieval and knowledge graph for structured reasoning, aiming to improve query relevance and response accuracy
- Results: NER improves the ability to classify user query intents. Hybrid retrieval reduced hallucination, improving factual consistency in generated responses
- In the predictive analysis, we label a stock as 1 if its performance exceeds that of the Nasdaq Index and 0 if it underperforms the Nasdaq Index
- Because of time series data, we use expanding-window cross-validation method to train the model
- We use LightGBM for predictions and leverage Optuna to tune the optimal parameters
- The results are: F1 Score is 0.5486 and AUC is 0.6693



Discussion and Conclusion

- HybridRAG reduces hallucination and improves the relevance of financial answers by combining vector search with knowledge graphs.
- NER helps clarify user intent, making it easier to route questions to the right model or data source.
- Prediction model performs well, achieving an F1 score of 0.55 and AUC of 0.67.

Future Work

- Improve model accuracy by integrating more real-time and high-frequency financial data.
- Expand to more tasks, such as event analysis or sentiment prediction.

References

- [1] Bhaskarjit Sarmah, Benika Hall, Rohan RaoSunil Patel, Stefano Pasquali, Dhagash Mehta HybridRAG: Integrating Knowledge Graphs and Vector Retrieval Augmented Generation for Efficient Information Extraction. (2024).
- [2] <https://medium.com/aimonks/mastering-the-waves-of-time-enhancing-predictive-accuracy-with-time-series-cross-validation-4eaccdaa5e2>